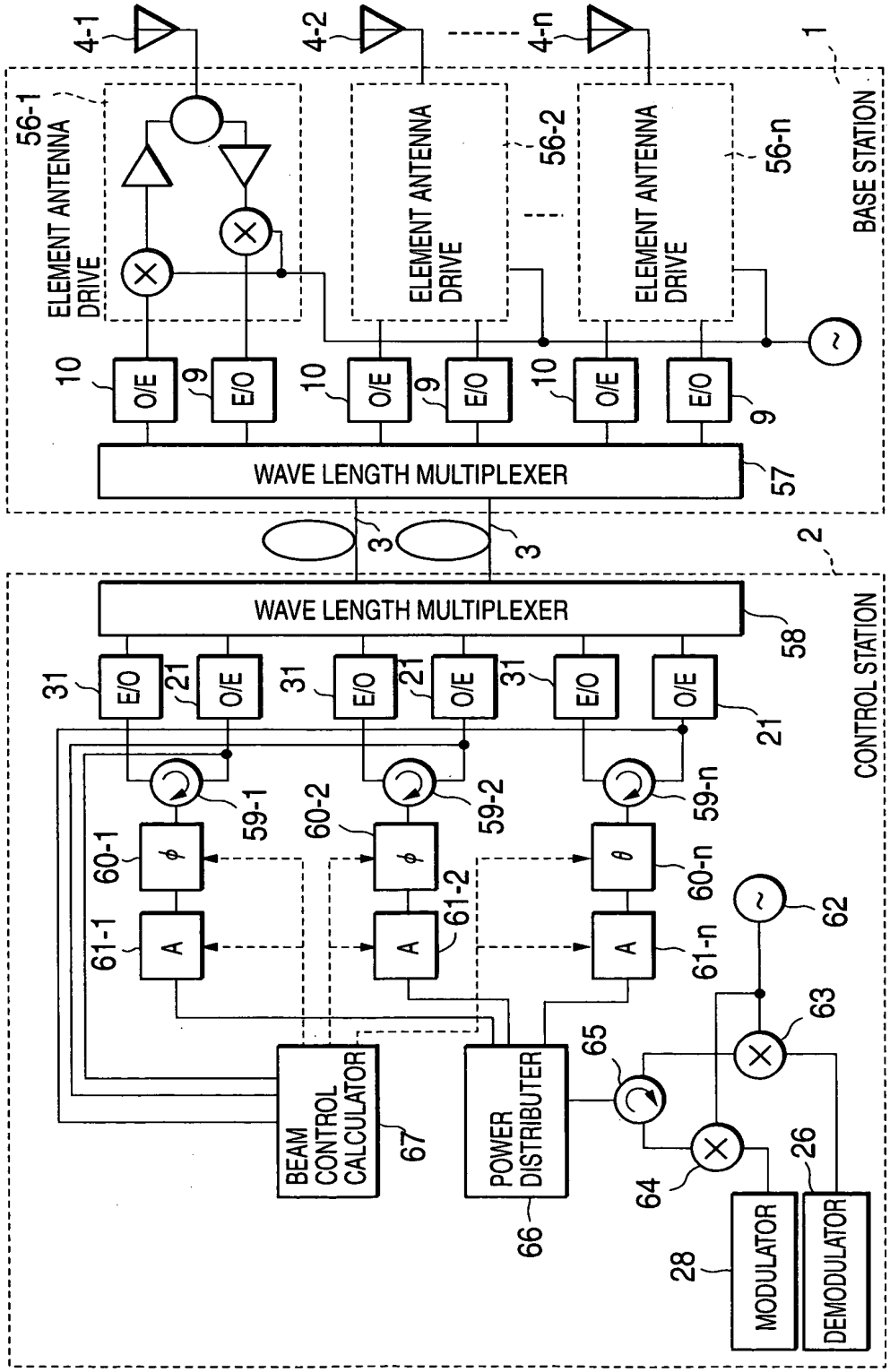

4-1
4-2
4-n
1
BASE STATION
56-1
ELEMENT ANTENNA DRIVE
56-2
56-n
10
O/E
9
E/O
WAVE LENGTH MULTIPLEXER
57
3
2
CONTROL STATION
58
31
21
59-1
59-2
59-n
60-1
60-2
60-n
61-1
61-2
61-n
A
62
63
65
64
26
28
MODULATOR
DEMODULATOR
BEAM CONTROL CALCULATOR
67
POWER DISTRIBUTER
66

FIG.1

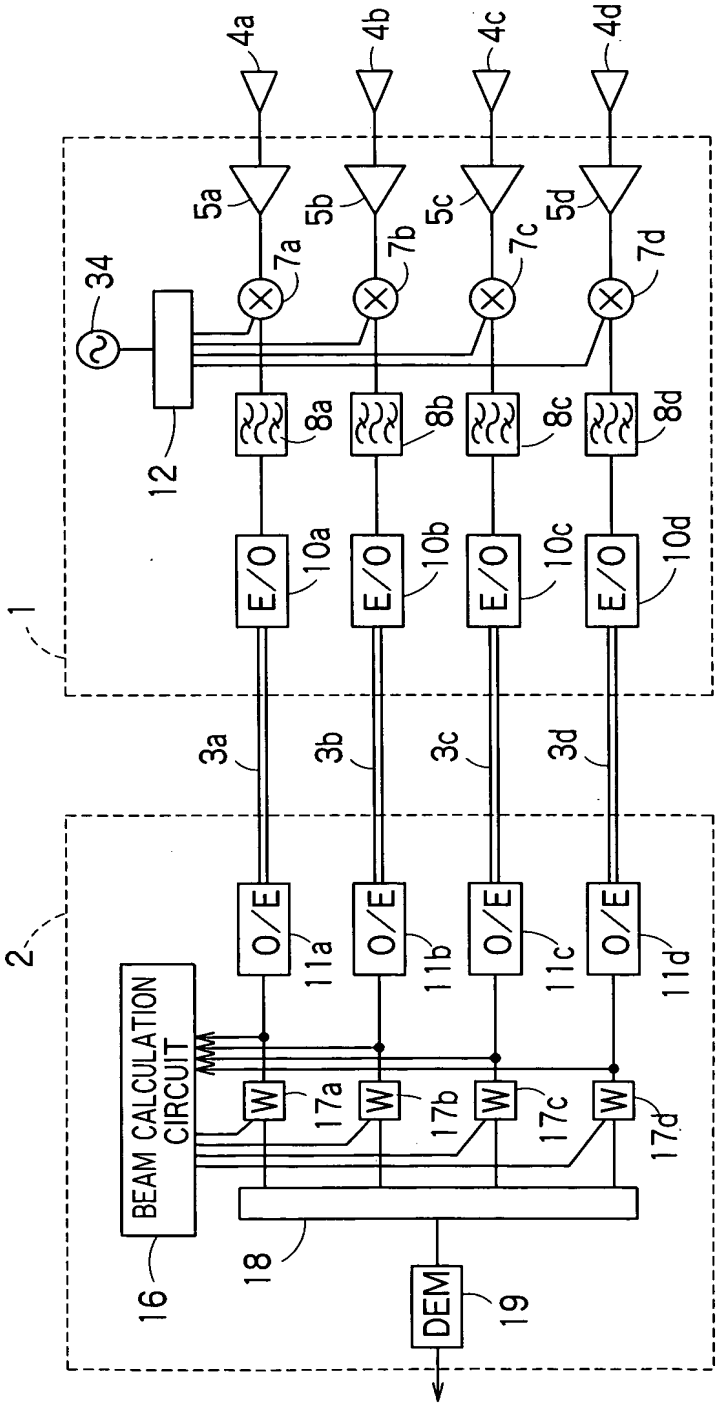

4a
4b
4c
4d
5a
5b
5c
5d
7a
7b
7c
7d
34
12
8a
8b
8c
8d
E/O
10a
10b
10c
10d
1
3a
3b
3c
3d
O/E
11a
11b
11c
11d
2
BEAM CALCULATION CIRCUIT
W
17a
17b
17c
17d
16
18
DEM
19

FIG. 2

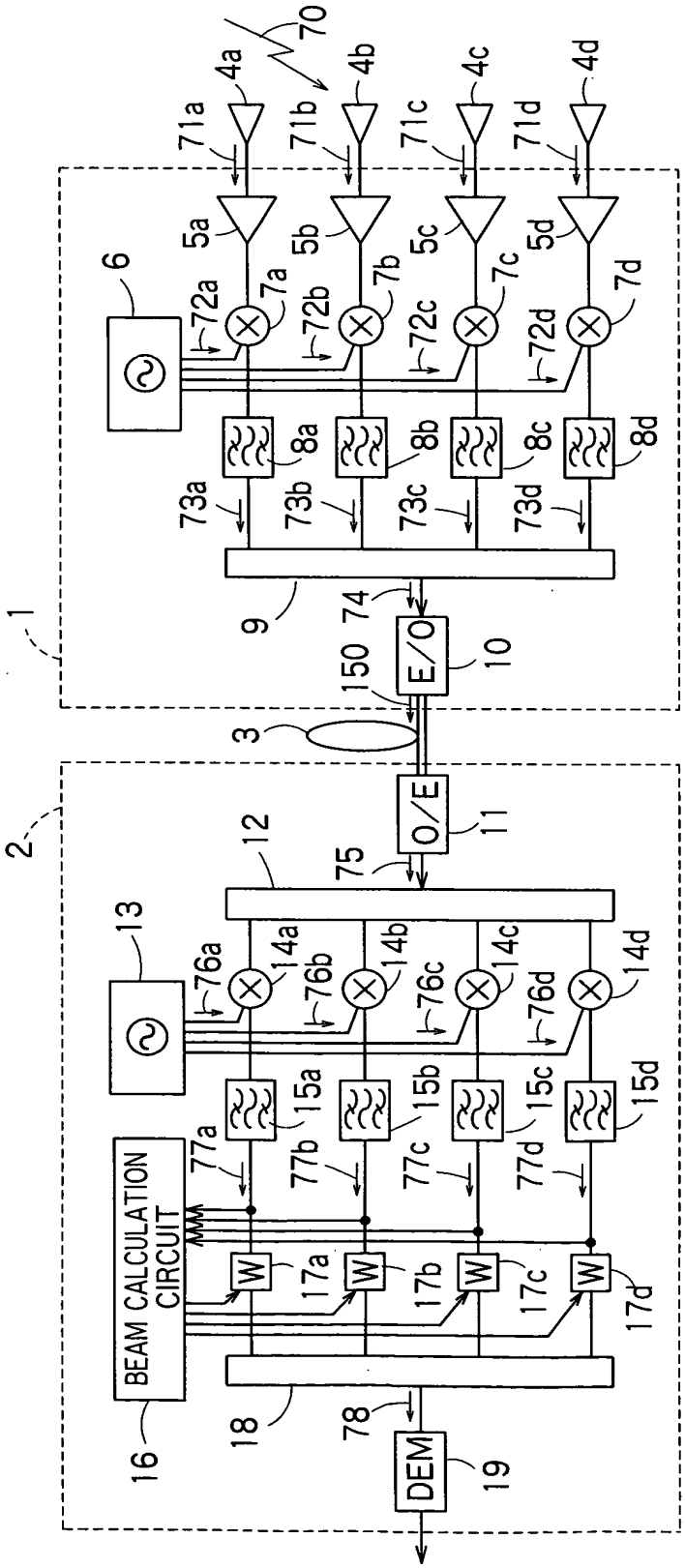

1
2
3
4a
4b
4c
4d
5a
5b
5c
5d
6
7a
7b
7c
7d
8a
8b
8c
8d
9
10
11
12
13
14a
14b
14c
14d
15a
15b
15c
15d
16
17a
17b
17c
17d
18
19
70
71a
71b
71c
71d
72a
72b
72c
72d
73a
73b
73c
73d
74
75
76a
76b
76c
76d
77a
77b
77c
77d
78
150
E/O
O/E
W
BEAM CALCULATION CIRCUIT
DEM

FIG. 3

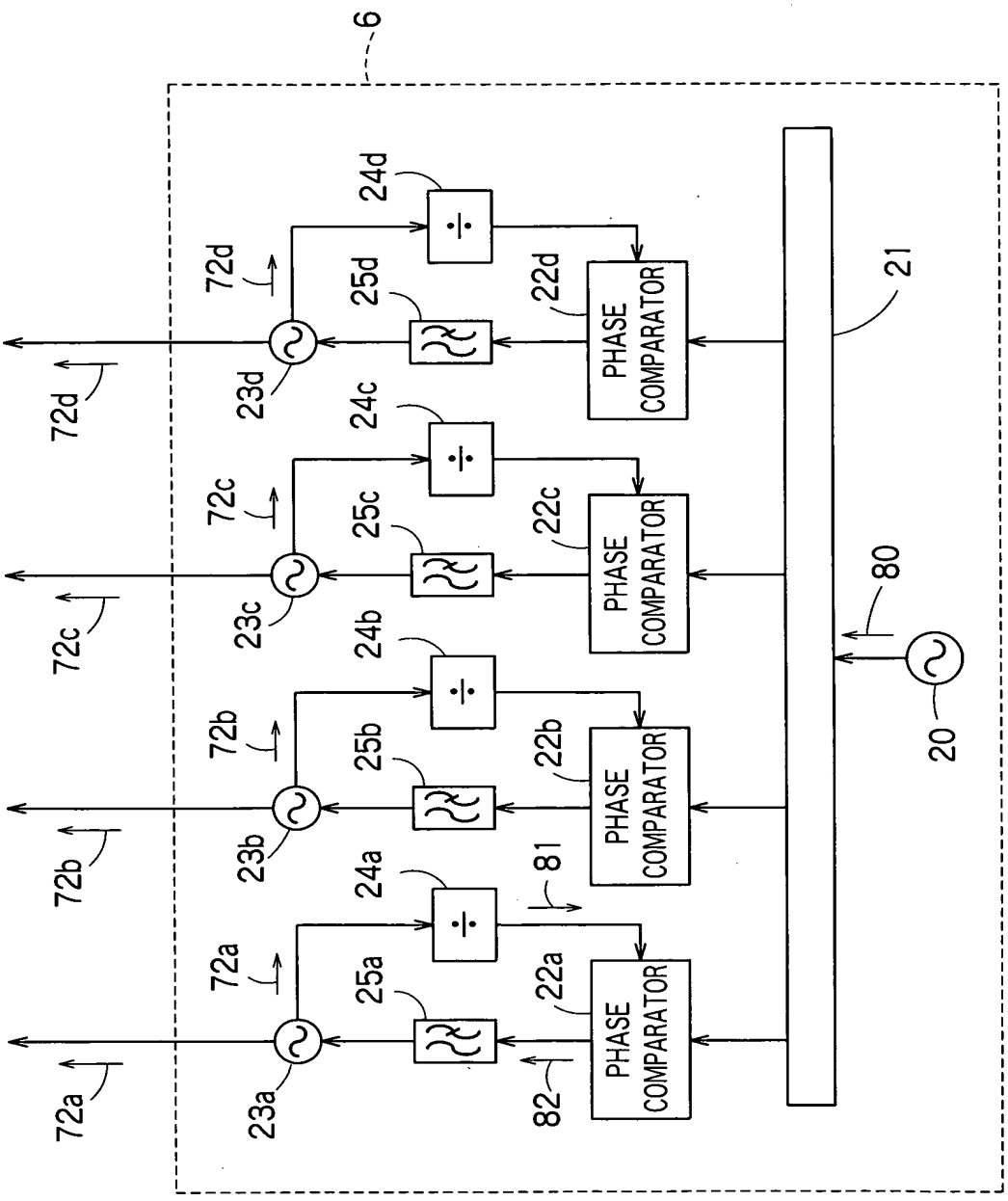

6
21
80
20
81
82
PHASE COMPARATOR
22a
22b
22c
22d
23a
23b
23c
23d
24a
24b
24c
24d
25a
25b
25c
25d
72a
72b
72c
72d

FIG. 4

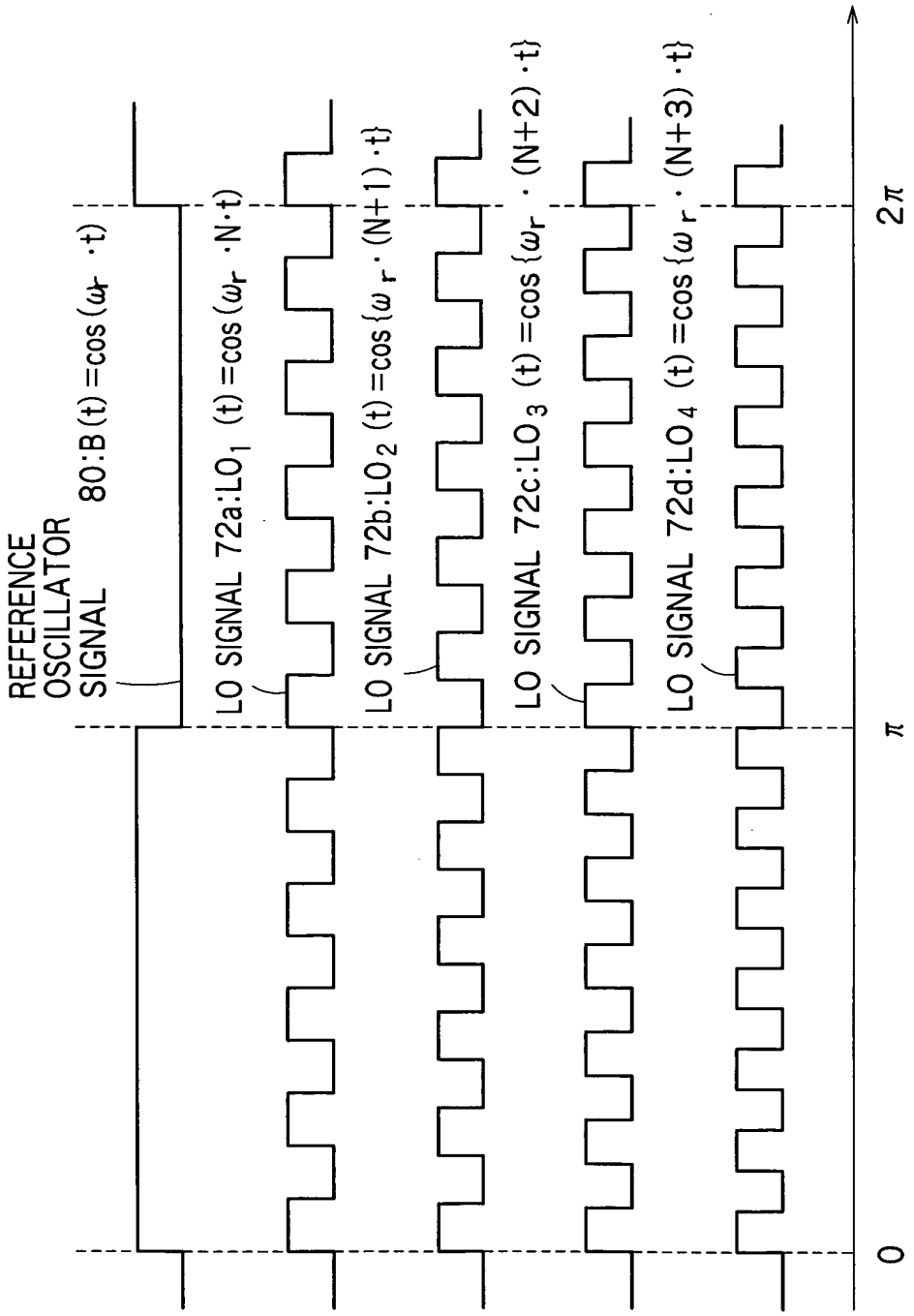
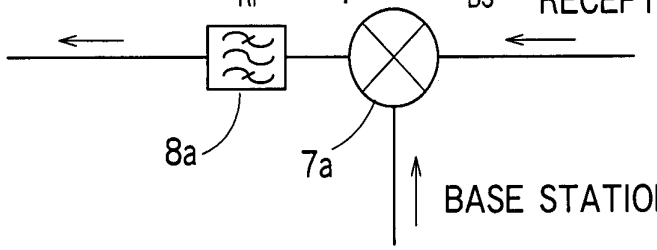

REFERENCE OSCILLATOR SIGNAL
80:B(t) =cos (ω_r ·t)
LO SIGNAL 72a:LO1 (t) =cos (ω_r ·N·t)
LO SIGNAL 72b:LO2 (t) =cos {ω_r · (N+1) ·t}
LO SIGNAL 72c:LO3 (t) =cos {ω_r · (N+2) ·t}
LO SIGNAL 72d:LO4 (t) =cos {ω_r · (N+3) ·t}
0
π
2π
PHASE φ

FIG. 5

RECEPTION SIGNAL 73a

$R'(t) = (1/2) \cdot \cos[(\omega_{RF} - N\omega_r)t - N\phi_{BS}]$

RECEPTION SIGNAL 71a $R(t) = \cos[\omega_{RF} t]$



BASE STATION LO SIGNAL 72a $LO_1(t) = \cos[N\omega_r t + N\phi_{BS}]$

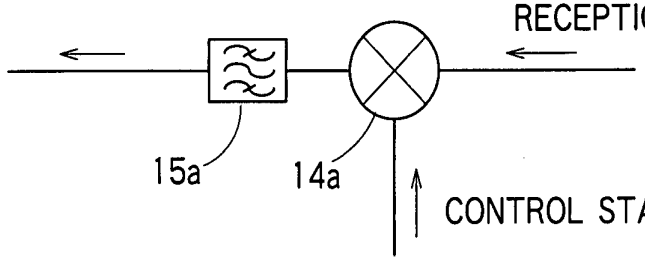
FIG. 6A

RECEPTION SIGNAL 77a

$R''(t) = (1/4) \cdot \cos[\{\omega_{RF} - N\omega_r - (N+3)\omega_r\}t' - N\phi_{BS} - (N+3)\phi_{CS}]$

$= (1/4) \cdot \cos[\omega_{IF} t' - N\phi_{BS} - (N+3)\phi_{CS}]$

RECEPTION SIGNAL 75 $R'(t) = (1/2) \cdot \cos[(\omega_{RF} - N\omega_{LO})t' - N\phi_{BS}]$



CONTROL STATION LO SIGNAL 76a $LO_2(t) = \cos[(N+3)\omega_r t' + (N+3)\phi_{CS}]$

FIG. 6B

OBLON ET AL (703) 413-3000
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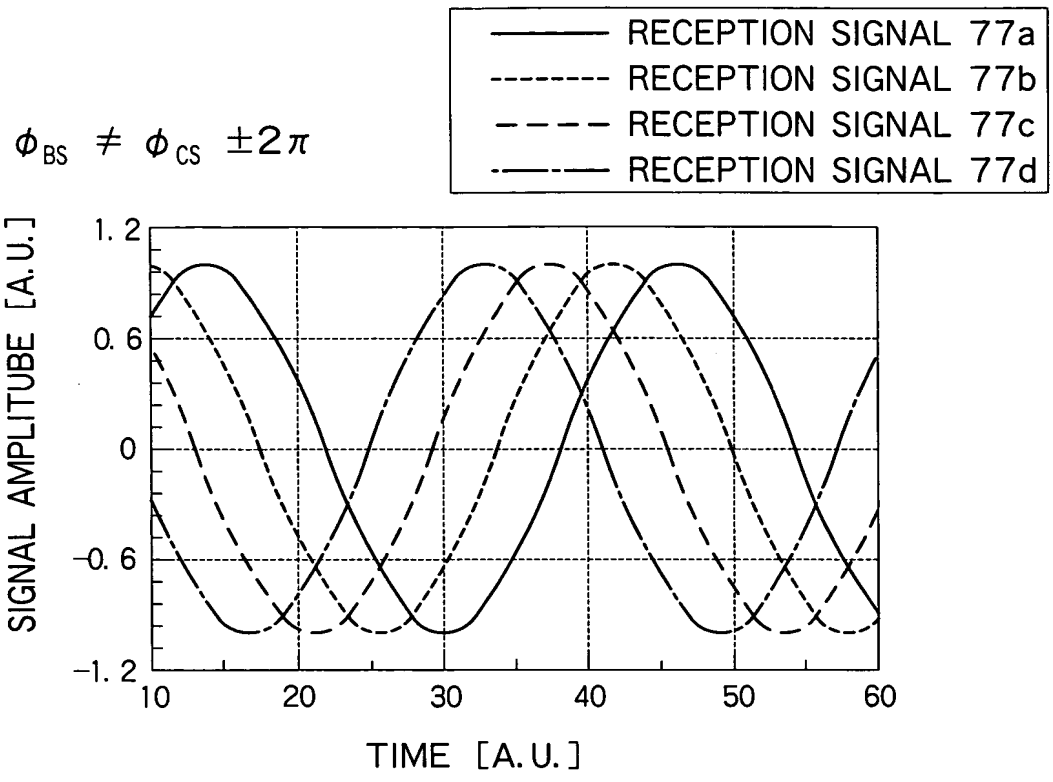

FIG. 7A

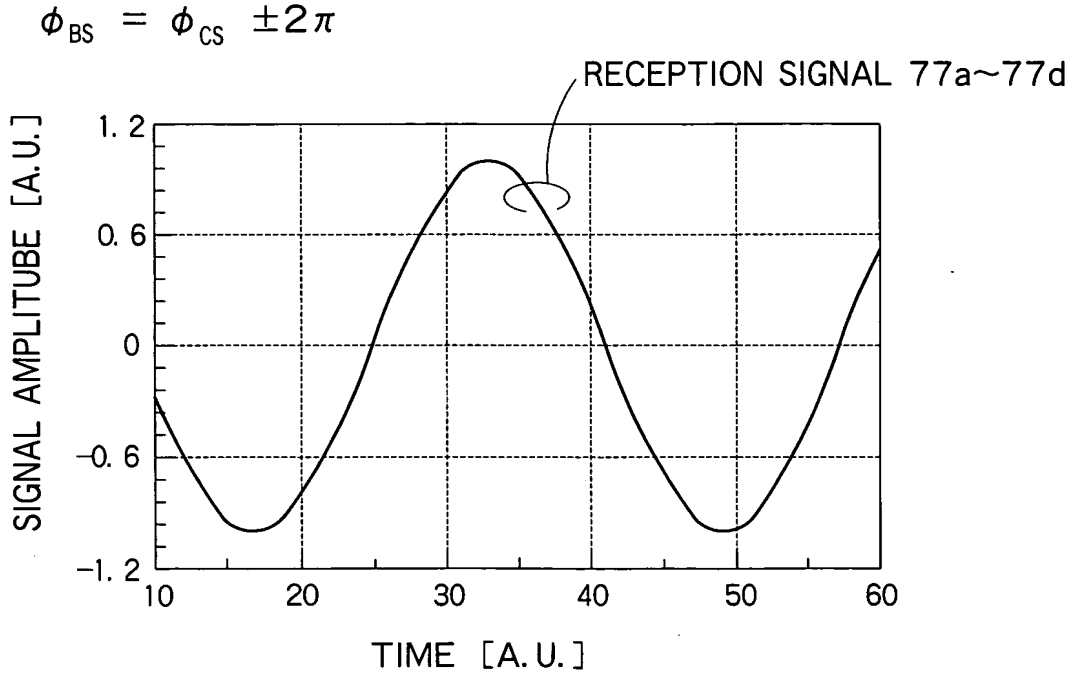

FIG. 7B

0021200 "0656045"

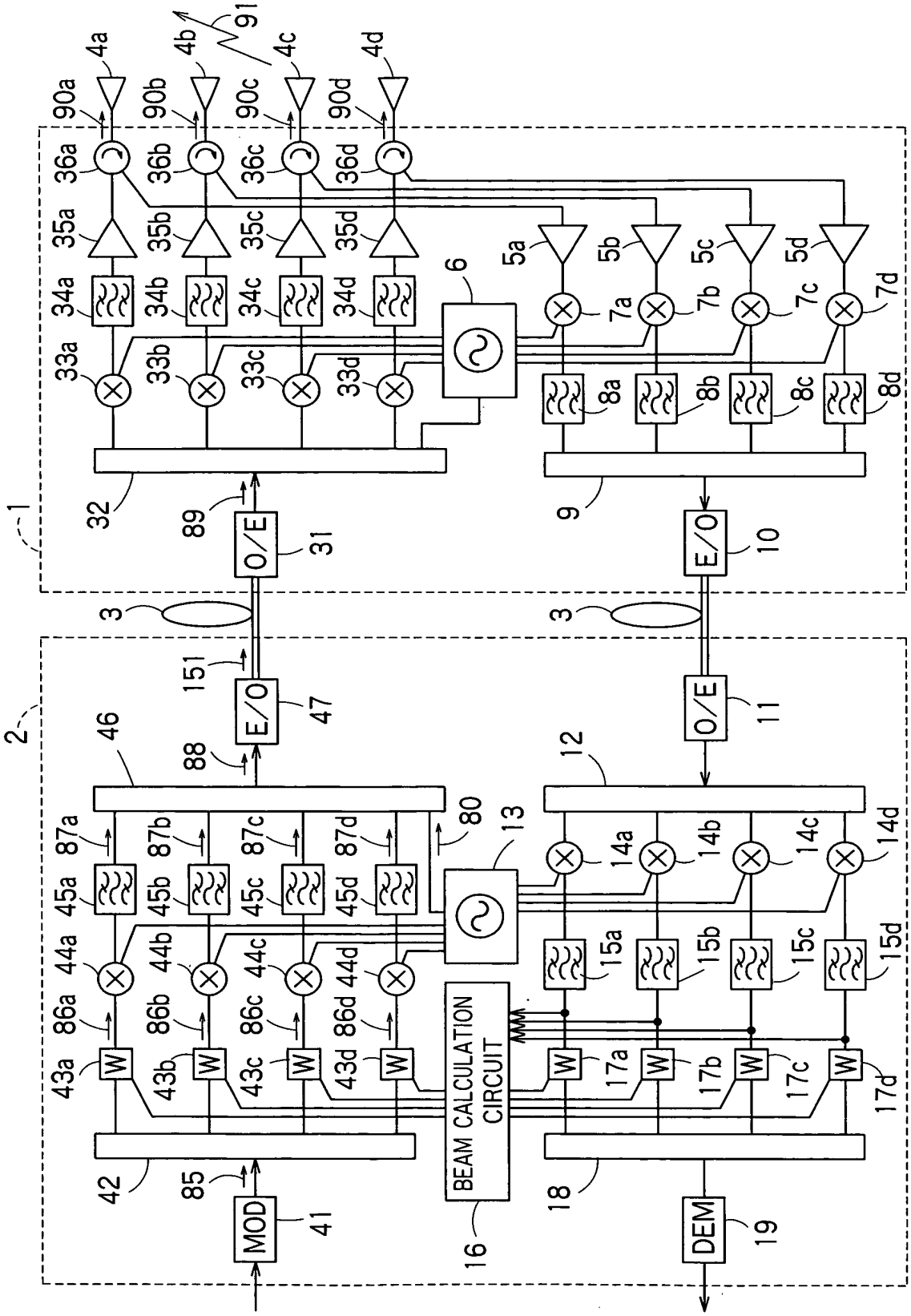

FIG. 8

"0027650" 2941096

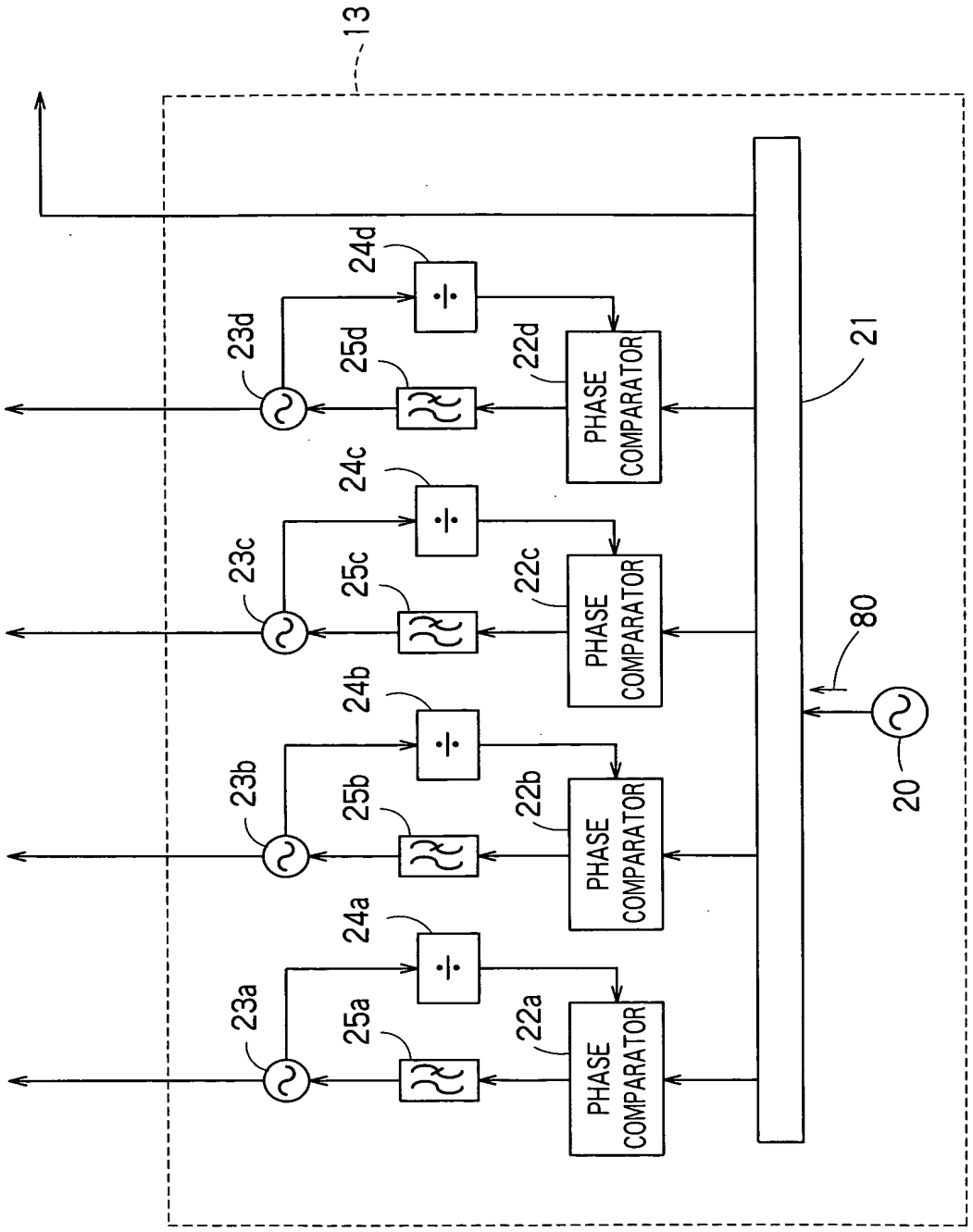

FIG. 9

0027650 "2940596D

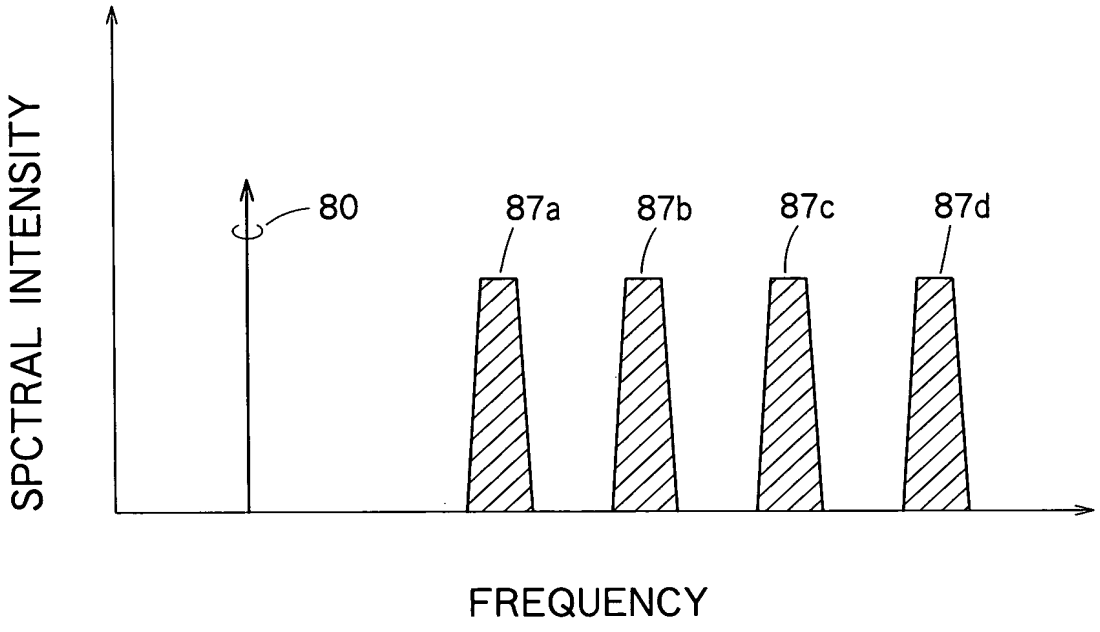

FIG. 10

05605457 - 082200

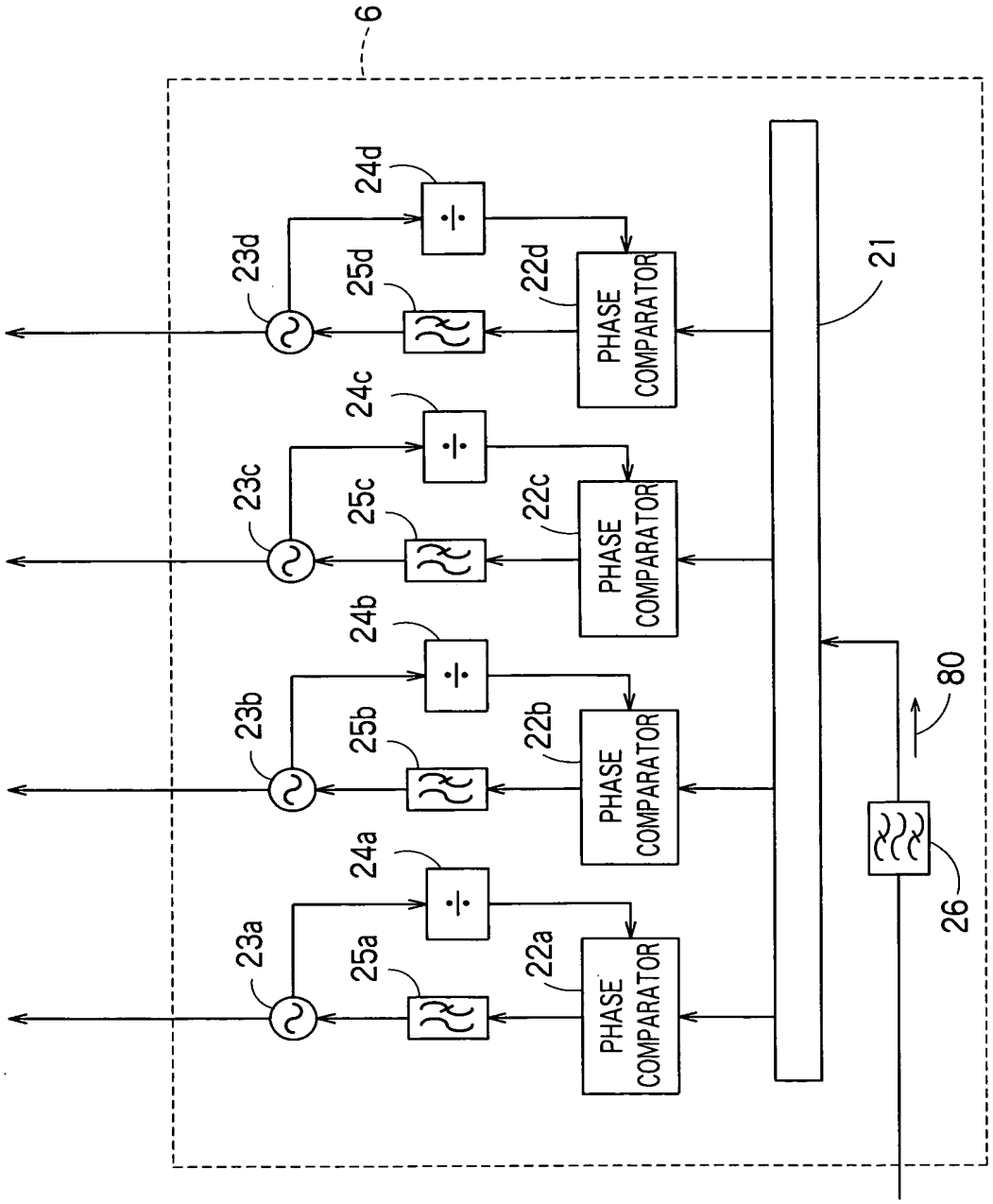
6
21
80
26
23a
23b
23c
23d
24a
24b
24c
24d
25a
25b
25c
25d
22a
22b
22c
22d
PHASE COMPARATOR
PHASE COMPARATOR
PHASE COMPARATOR
PHASE COMPARATOR

FIG. 11

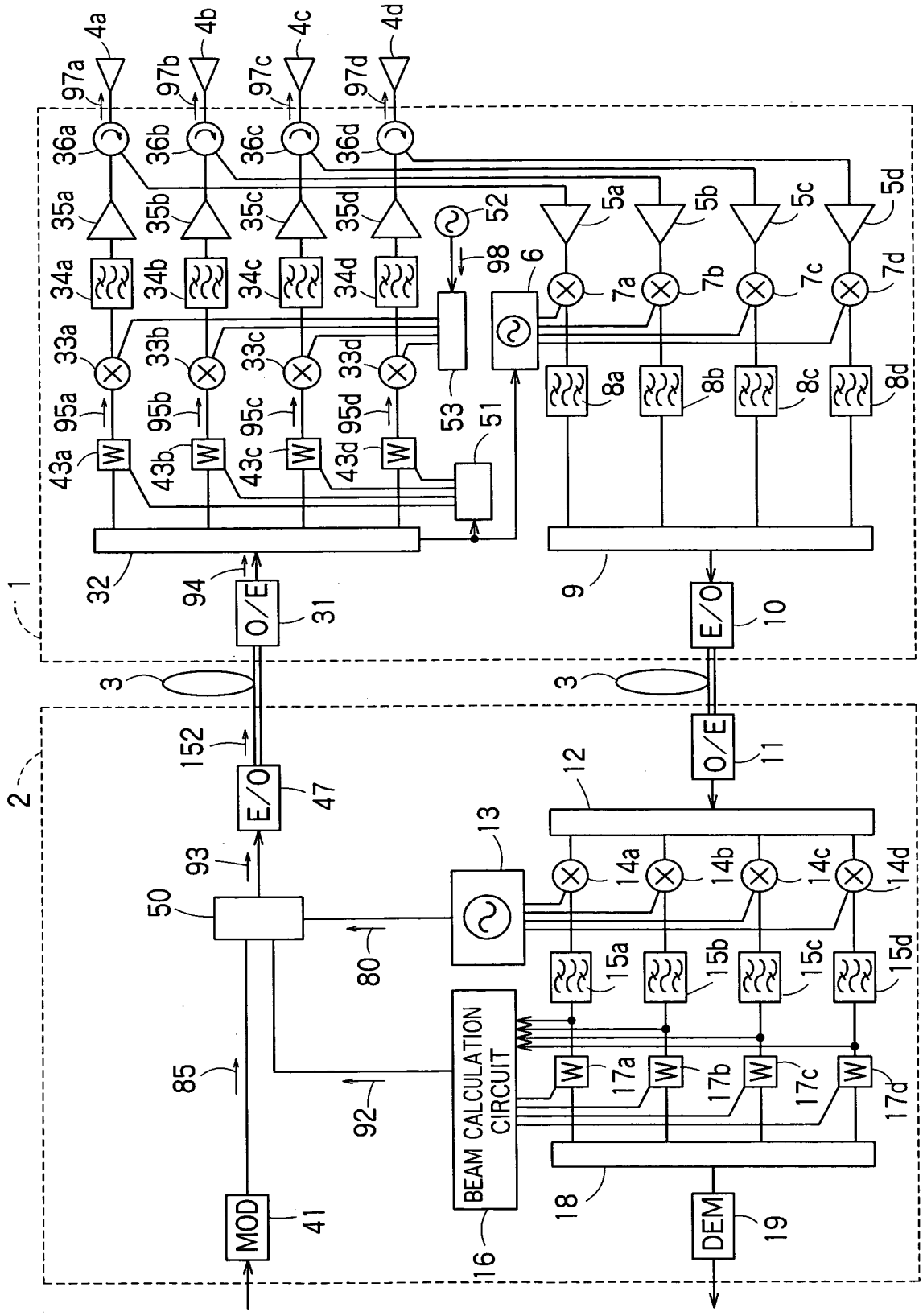
1
2
3
4a
4b
4c
4d
5a
5b
5c
5d
6
7a
7b
7c
7d
8a
8b
8c
8d
9
10
11
12
13
14a
14b
14c
14d
15a
15b
15c
15d
16
17a
17b
17c
17d
18
19
31
32
41
47
50
51
52
53
80
85
92
93
94
95a
95b
95c
95d
97a
97b
97c
97d
98
152
33a
33b
33c
33d
34a
34b
34c
34d
35a
35b
35c
35d
36a
36b
36c
36d
43a
43b
43c
43d
W
O/E
E/O
MOD
DEM
BEAM CALCULATION CIRCUIT

FIG. 12

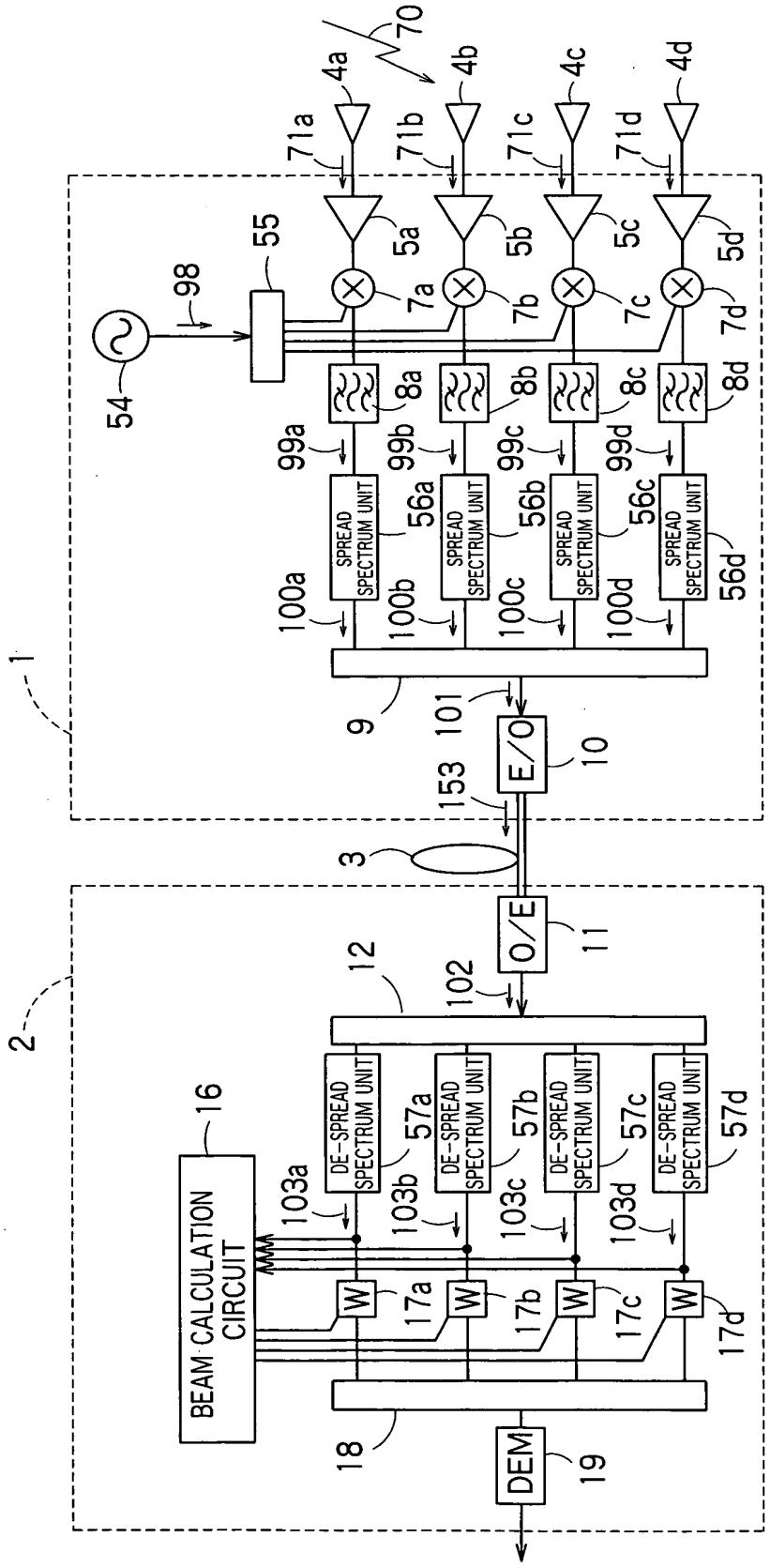
1
2
3
4a
4b
4c
4d
5a
5b
5c
5d
7a
7b
7c
7d
8a
8b
8c
8d
9
10
11
12
16
17a
17b
17c
17d
18
19
54
55
70
71a
71b
71c
71d
98
99a
99b
99c
99d
100a
100b
100c
100d
101
102
103a
103b
103c
103d
153
56a
56b
56c
56d
57a
57b
57c
57d
SPREAD SPECTRUM UNIT
DE-SPREAD SPECTRUM UNIT
E/O
O/E
W
DEM
BEAM CALCULATION CIRCUIT

FIG. 13

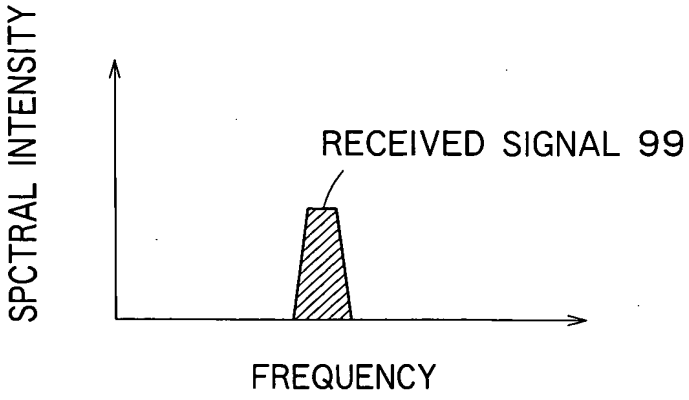

FIG. 14A

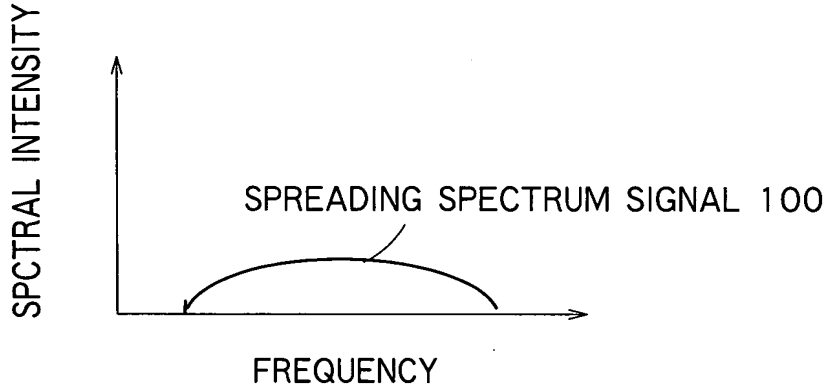

FIG. 14B

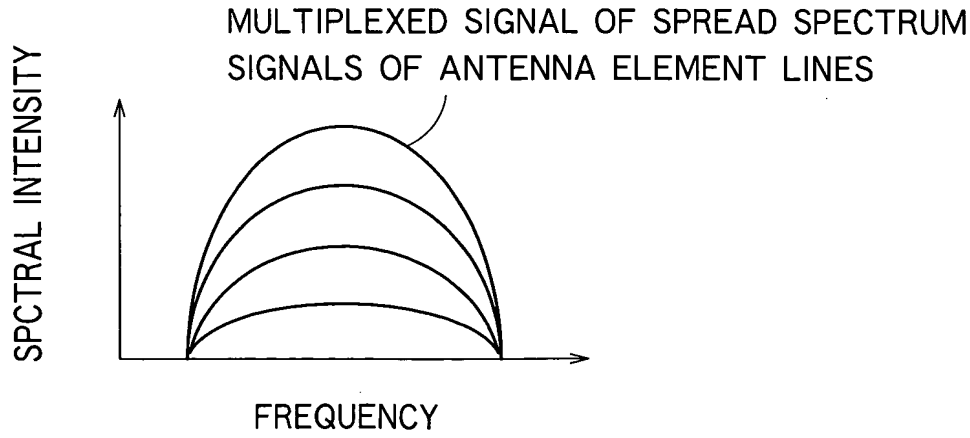

FIG. 14C

0027650 "2940950

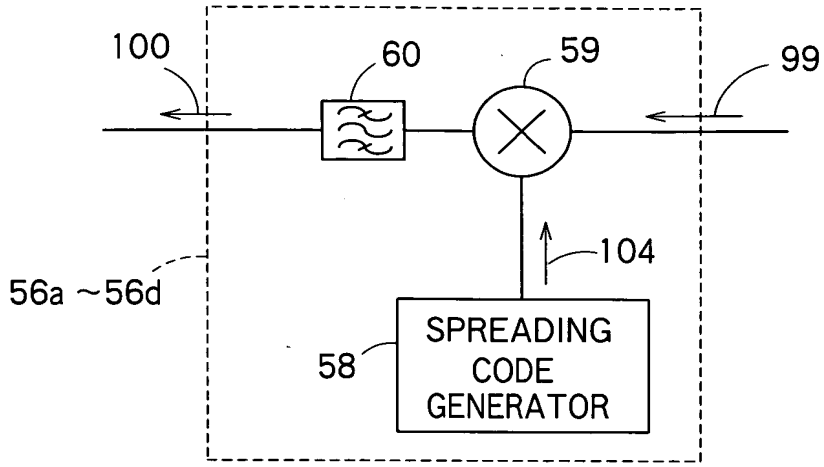

FIG. 15A

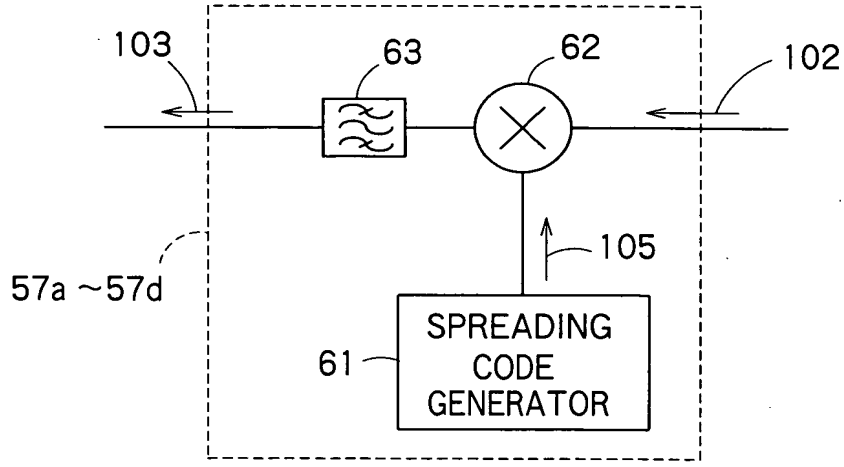

FIG. 15B

0956045 0956045

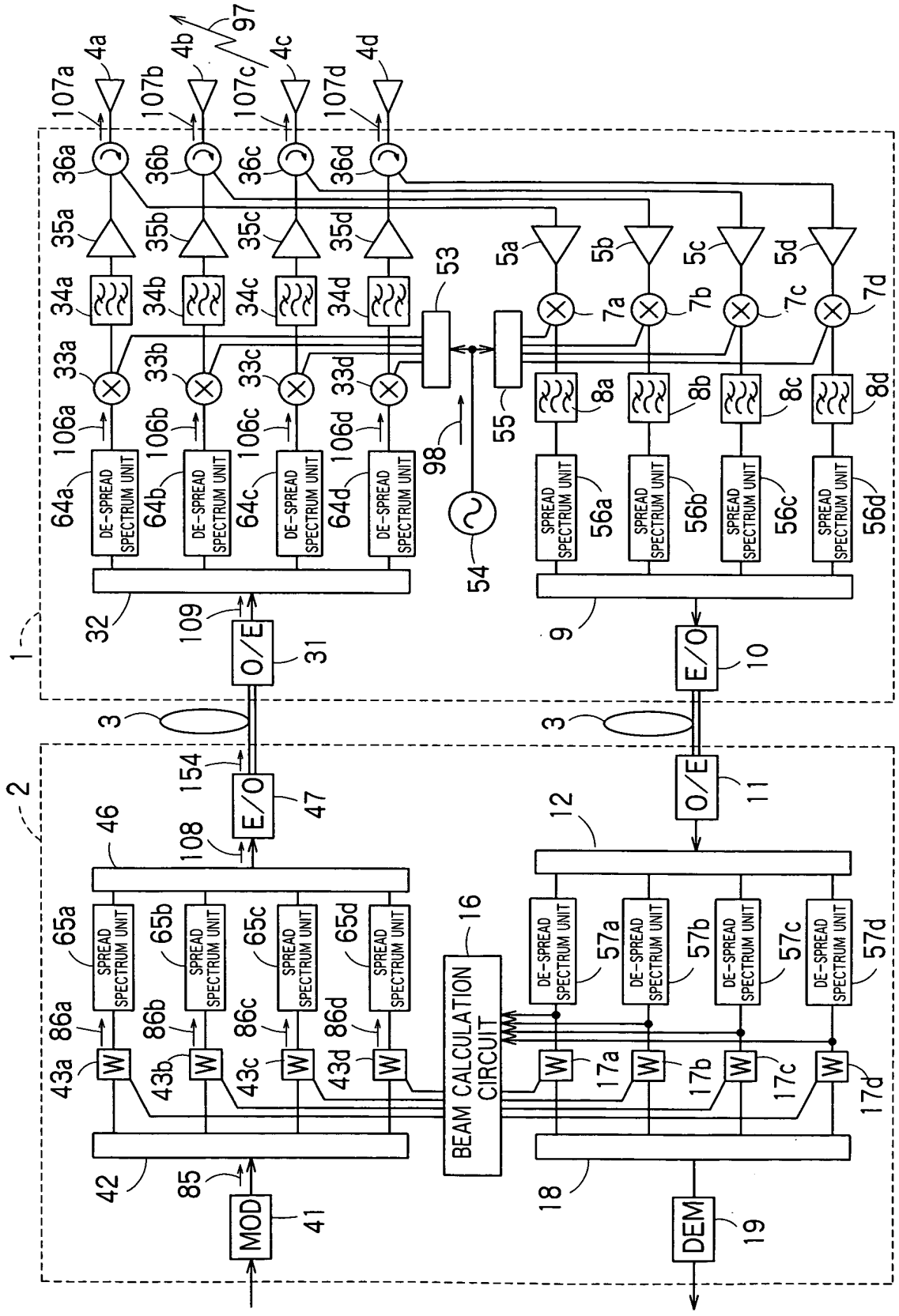
1
2
3
4a
4b
4c
4d
5a
5b
5c
5d
7a
7b
7c
7d
8a
8b
8c
8d
9
10
11
12
16
17a
17b
17c
17d
18
19
31
32
41
42
46
47
53
54
55
56a
56b
56c
56d
57a
57b
57c
57d
97
98
107a
107b
107c
107d
109
154
BEAM CALCULATION CIRCUIT
DE-SPREAD SPECTRUM UNIT
SPREAD SPECTRUM UNIT
O/E
E/O
MOD
DEM
W

FIG. 16

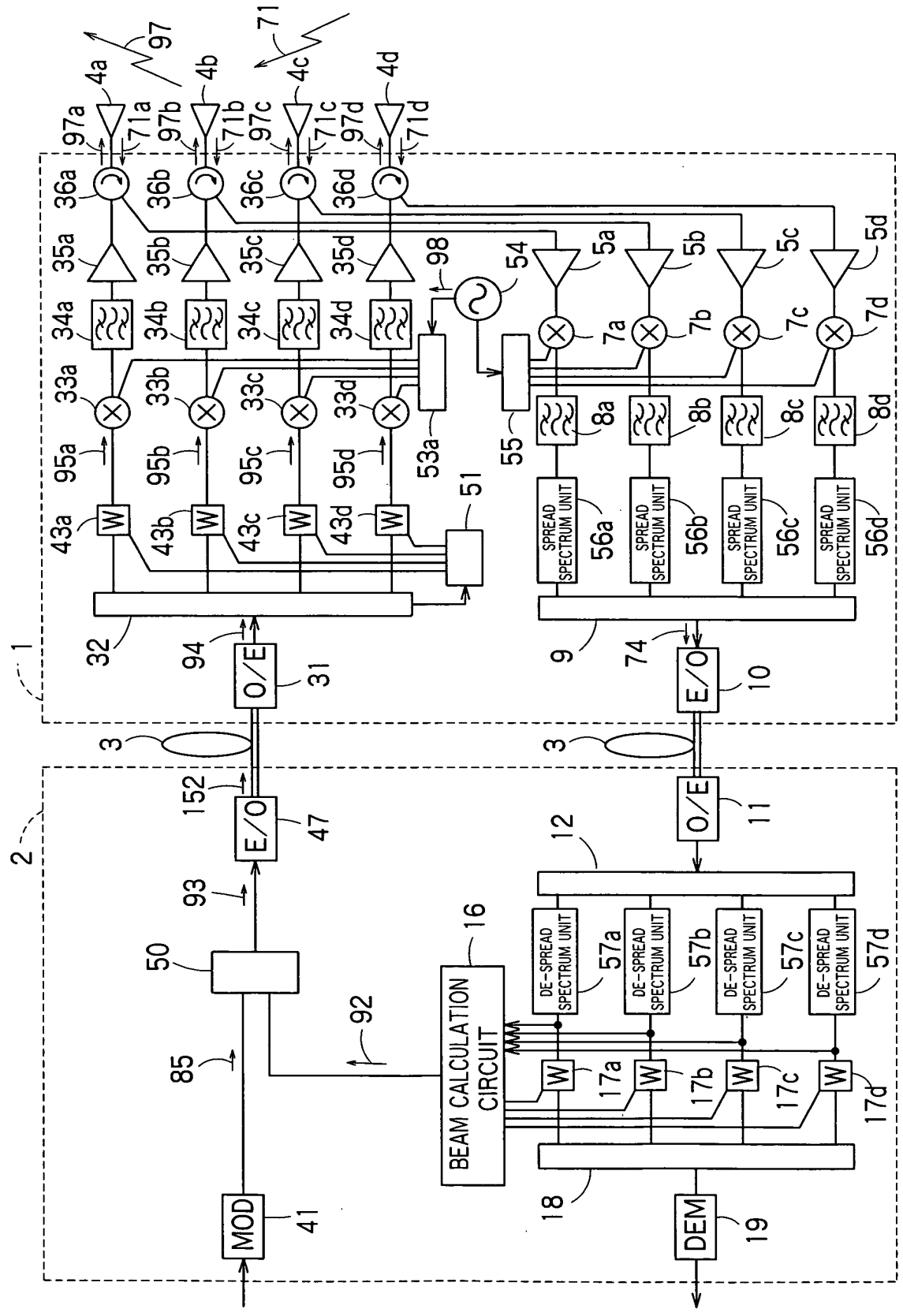

FIG. 17

0027650 "2540960

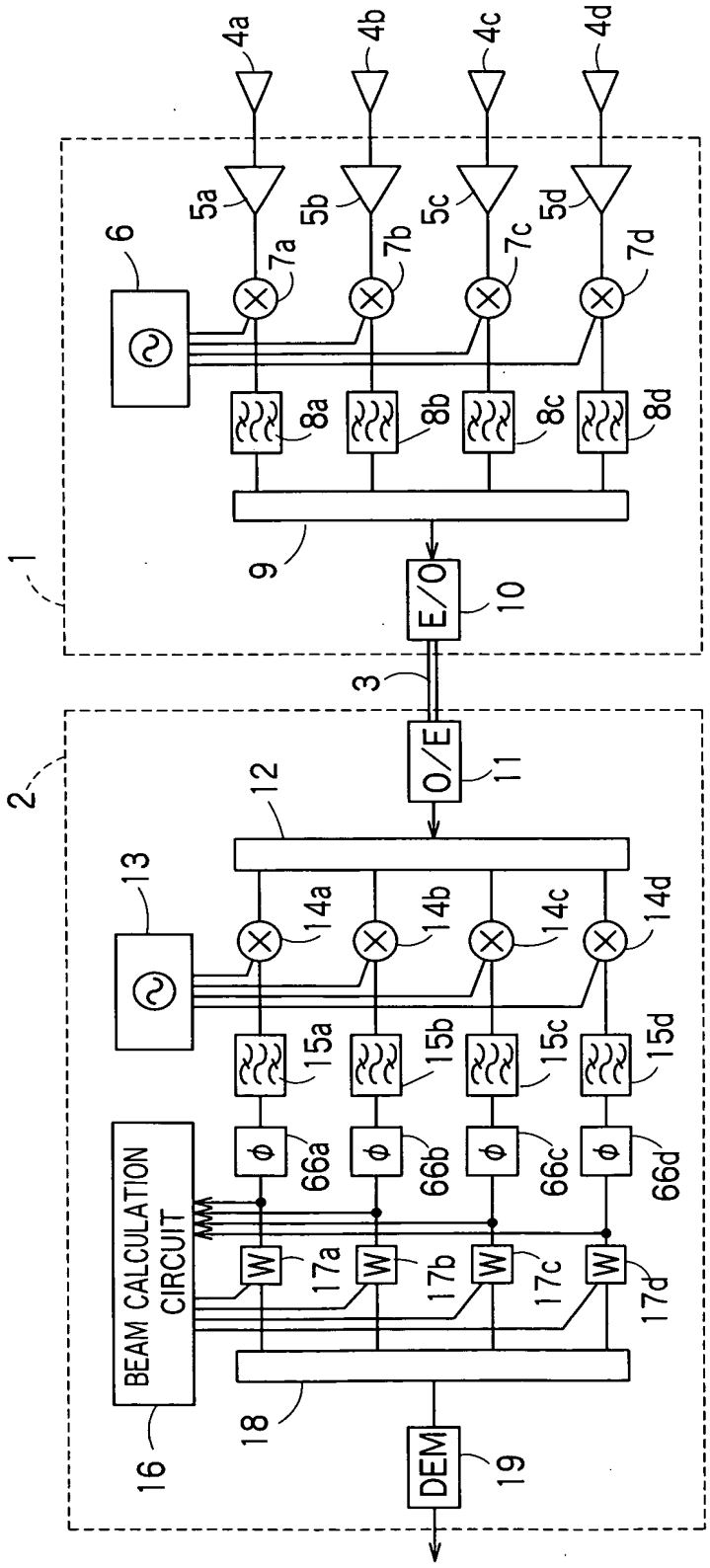

FIG. 18

0027450 "JP-05-95950

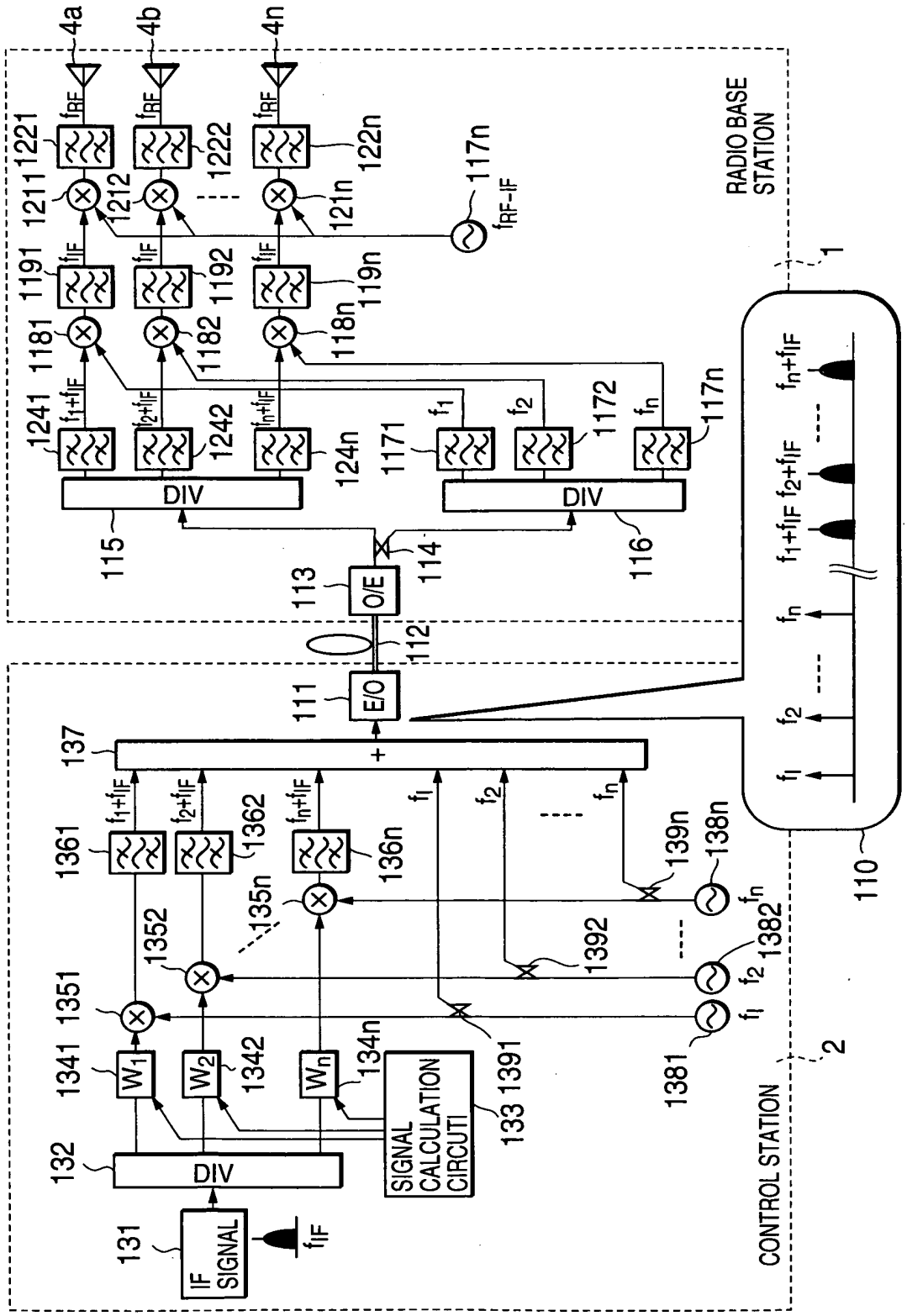
RADIO BASE STATION
CONTROL STATION
DIV
SIGNAL CALCULATION CIRCUIT
IF SIGNAL
O/E
E/O

FIG.19

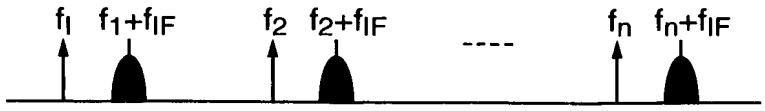
f_1
f_1+f_{IF}
f_2
f_2+f_{IF}
f_n
f_n+f_{IF}

FIG.20

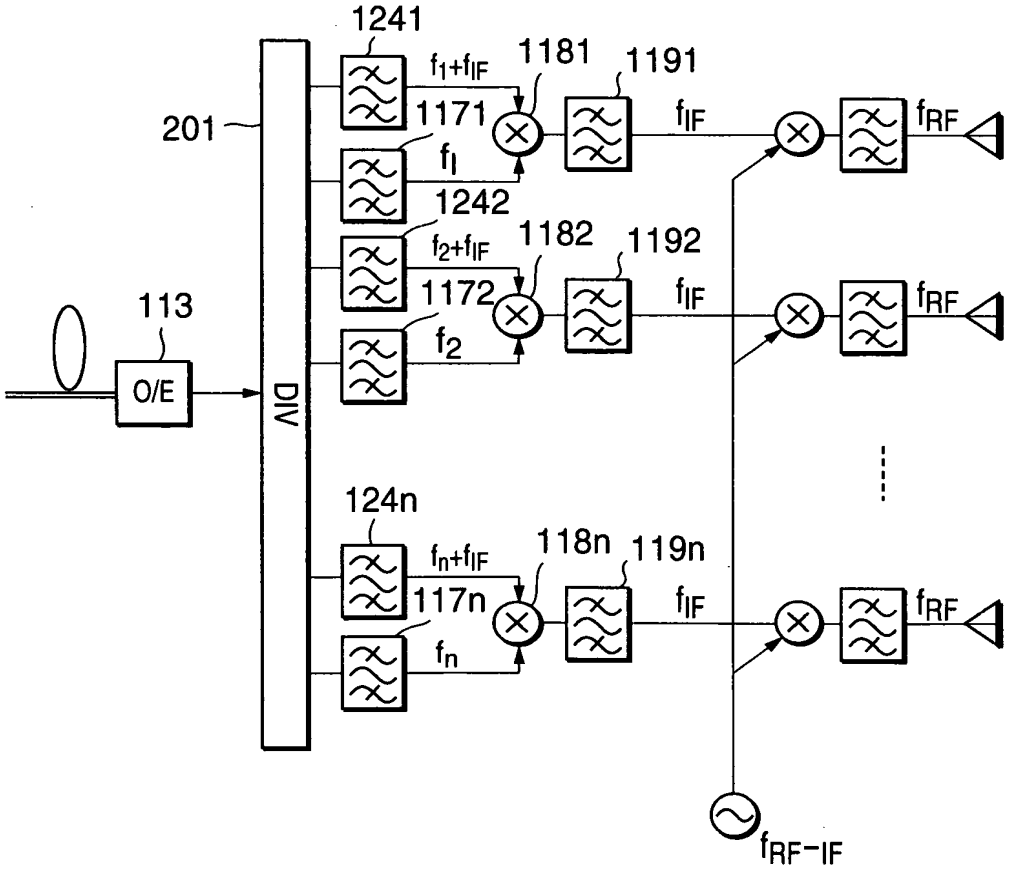
1241
1181
1191
201
f_1+f_{IF}
1171
f_{IF}
f_{RF}
f_1
1242
1182
1192
f_2+f_{IF}
113
1172
f_{IF}
f_{RF}
O/E
DIV
f_2
124n
118n
119n
f_n+f_{IF}
117n
f_{IF}
f_{RF}
f_n
f_{RF-IF}

FIG.21

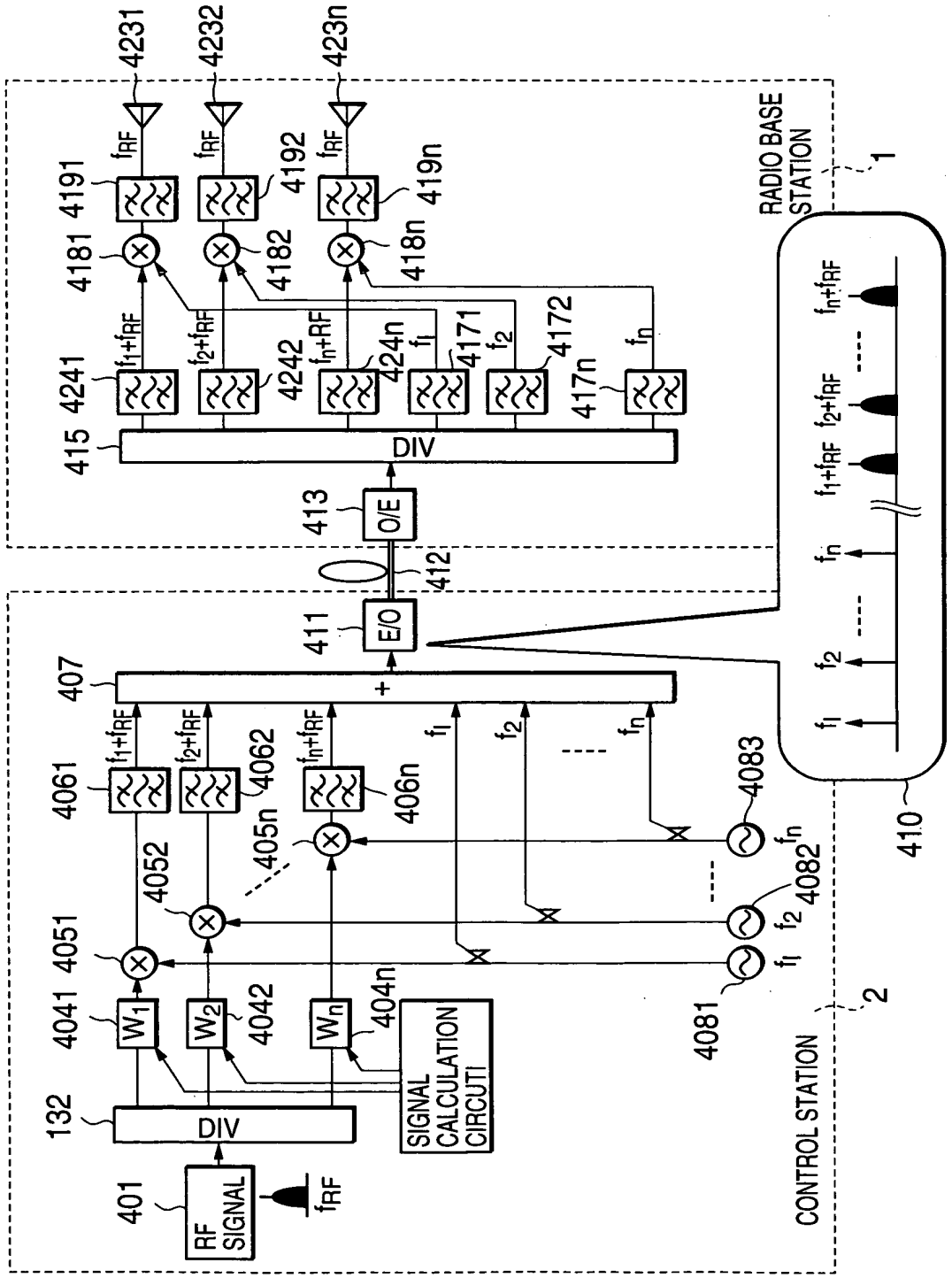
RADIO BASE STATION
1
CONTROL STATION
2
RF SIGNAL
DIV
SIGNAL CALCULATION CIRCUIT
DIV
O/E
E/O
+

FIG.22

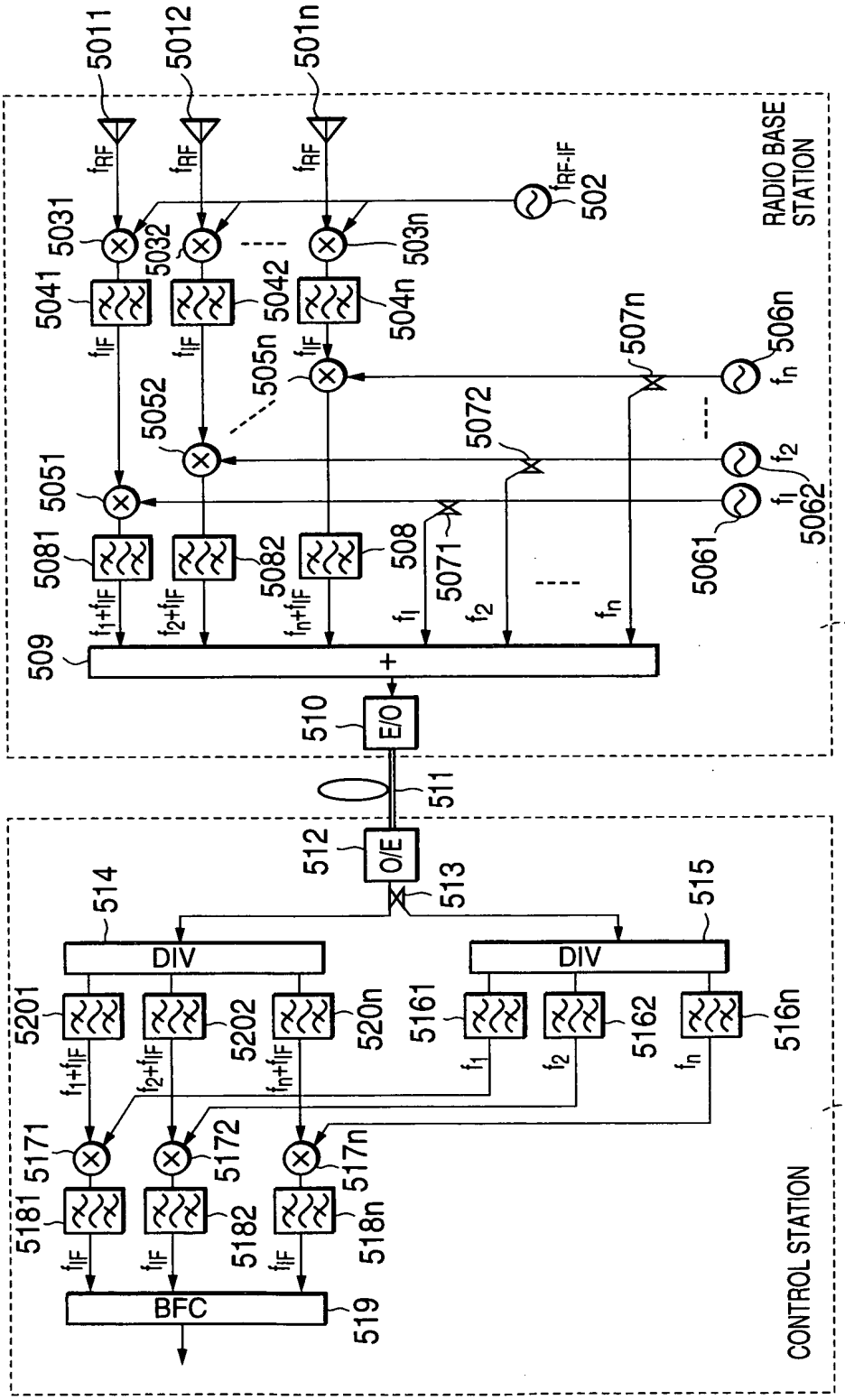

FIG.23

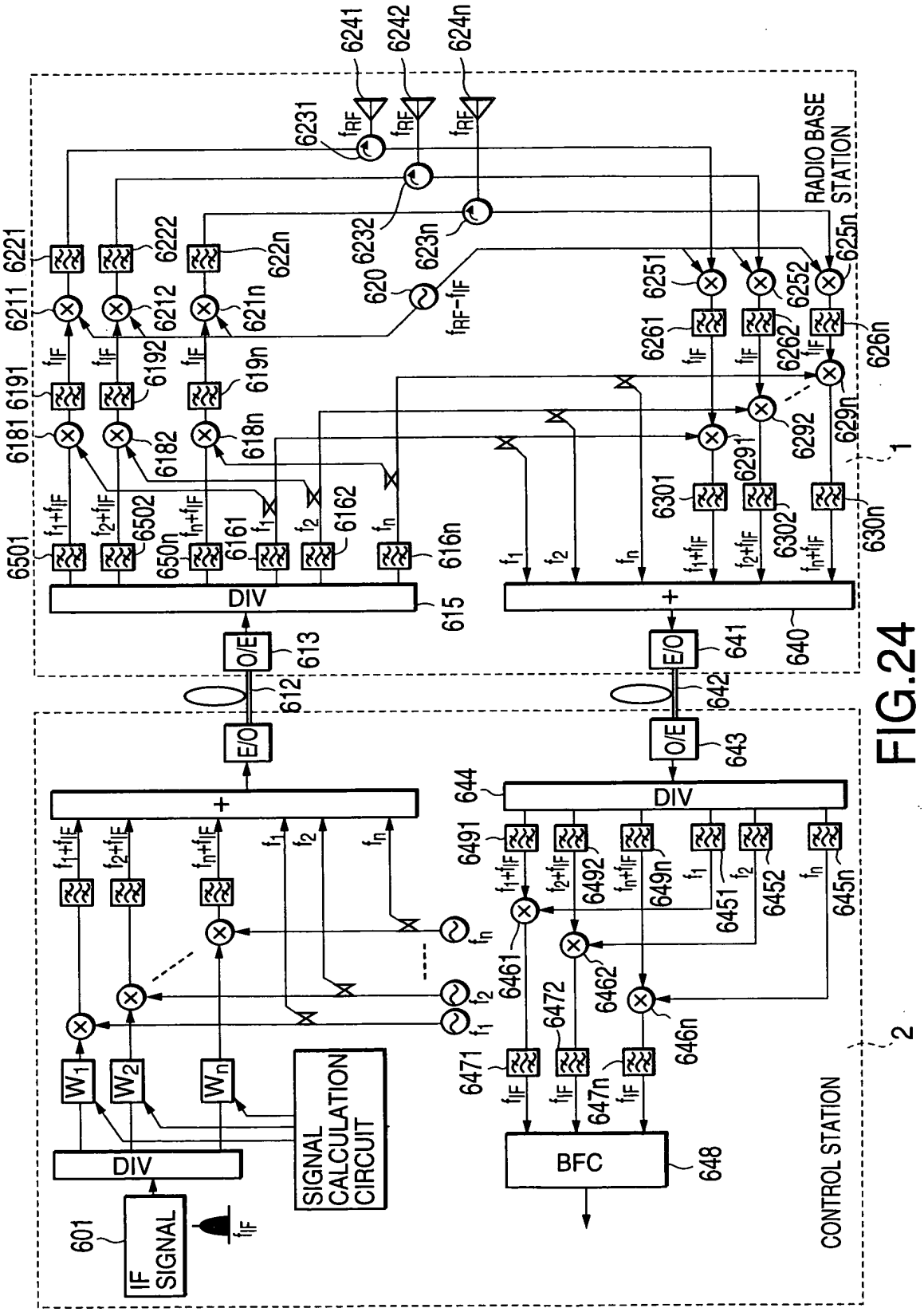
RADIO BASE STATION
CONTROL STATION
DIV
SIGNAL CALCULATION CIRCUIT
BFC
IF SIGNAL
E/O
O/E

FIG.24

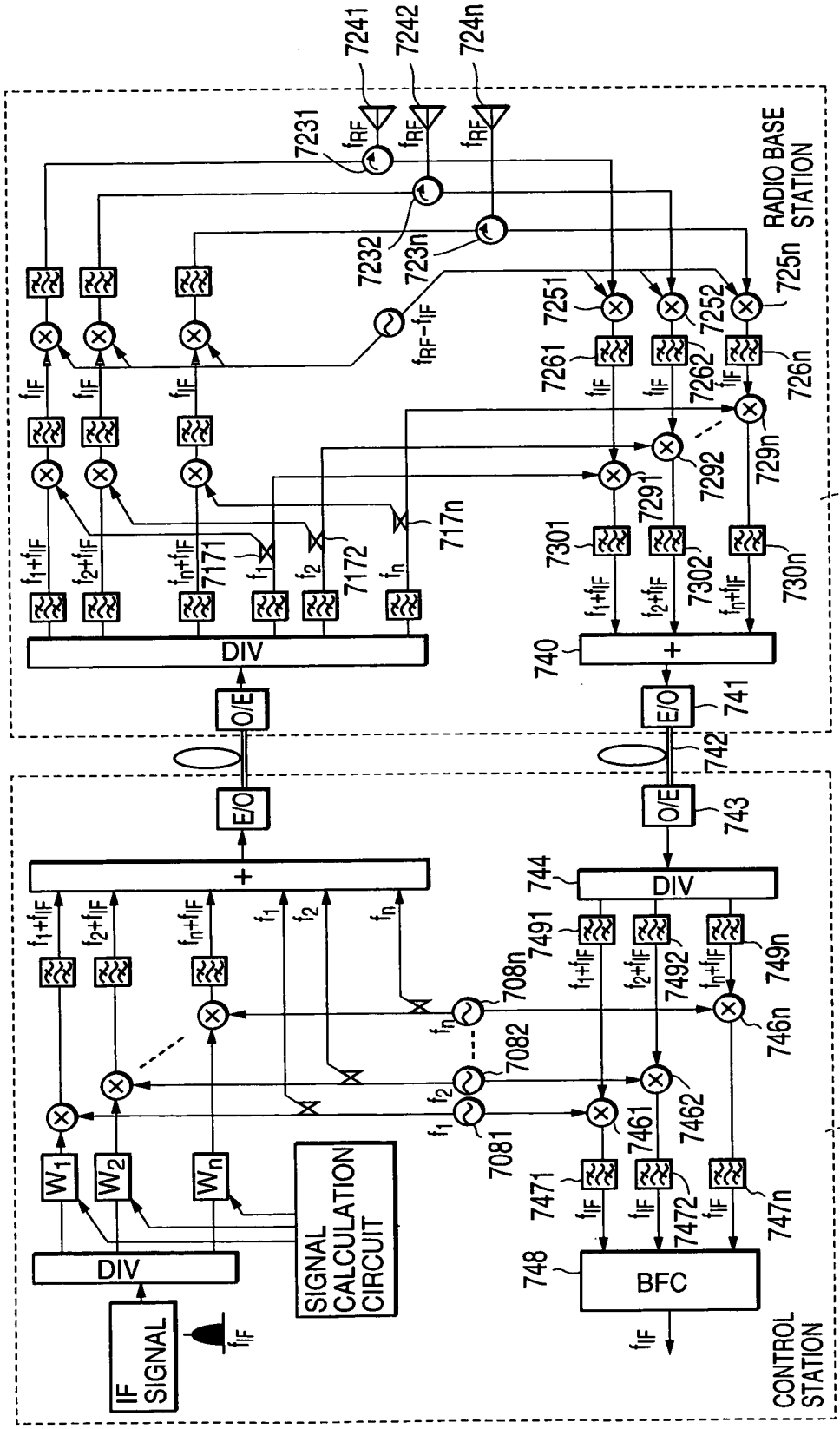
RADIO BASE STATION
CONTROL STATION
DIV
SIGNAL CALCULATION CIRCUIT
IF SIGNAL
BFC
O/E
E/O
1
2

FIG.25

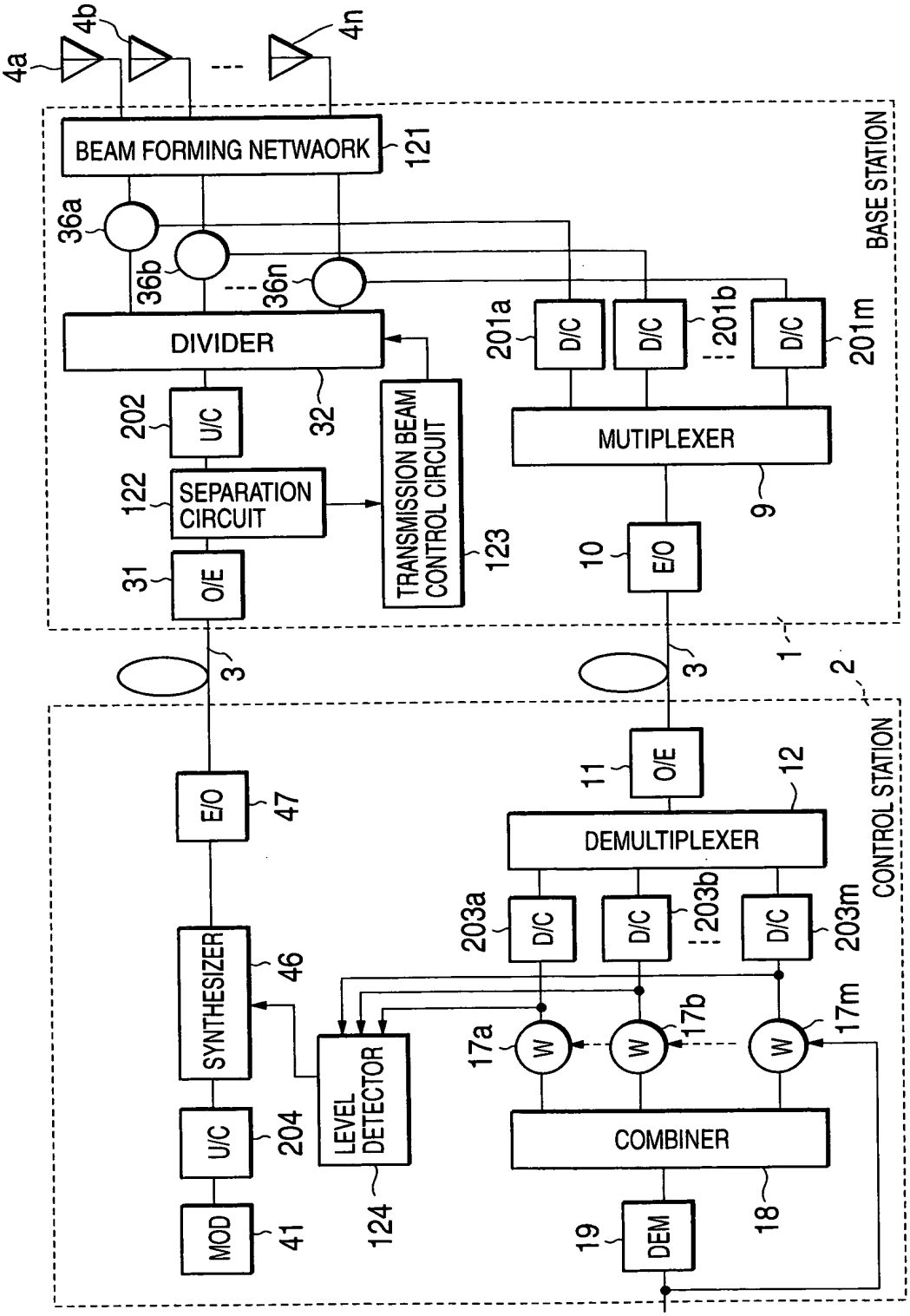
4a
4b
4n
BEAM FORMING NETWAORK
121
36a
36b
36n
DIVIDER
32
202
U/C
122
SEPARATION CIRCUIT
31
O/E
TRANSMISSION BEAM CONTROL CIRCUIT
123
201a
D/C
D/C
201b
D/C
201m
MUTIPLEXER
9
10
E/O
BASE STATION
1
2
3
3
E/O
47
SYNTHESIZER
46
U/C
204
MOD
41
LEVEL DETECTOR
124
11
O/E
12
DEMULTIPLEXER
203a
D/C
D/C
203b
D/C
203m
17a
W
W
17b
W
17m
COMBINER
18
19
DEM
CONTROL STATION

FIG.26

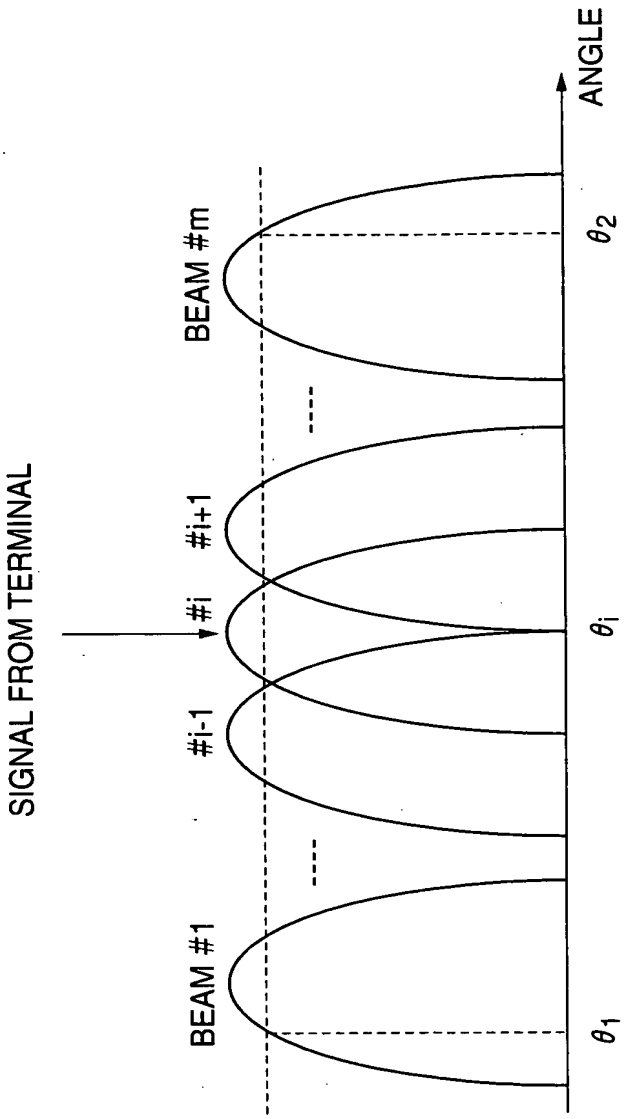

FIG.27A

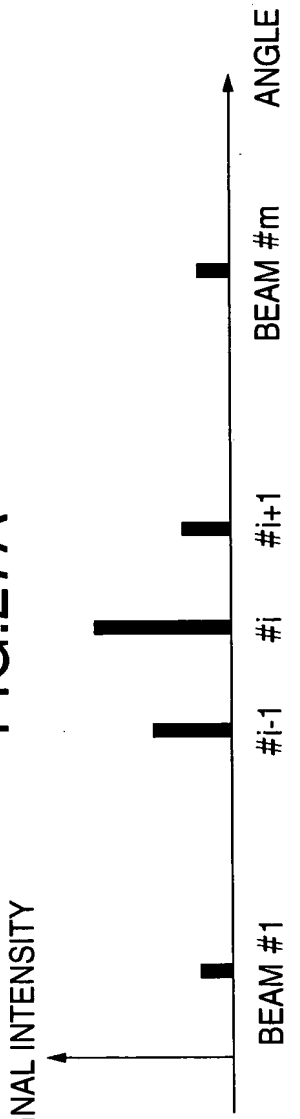

FIG.27B

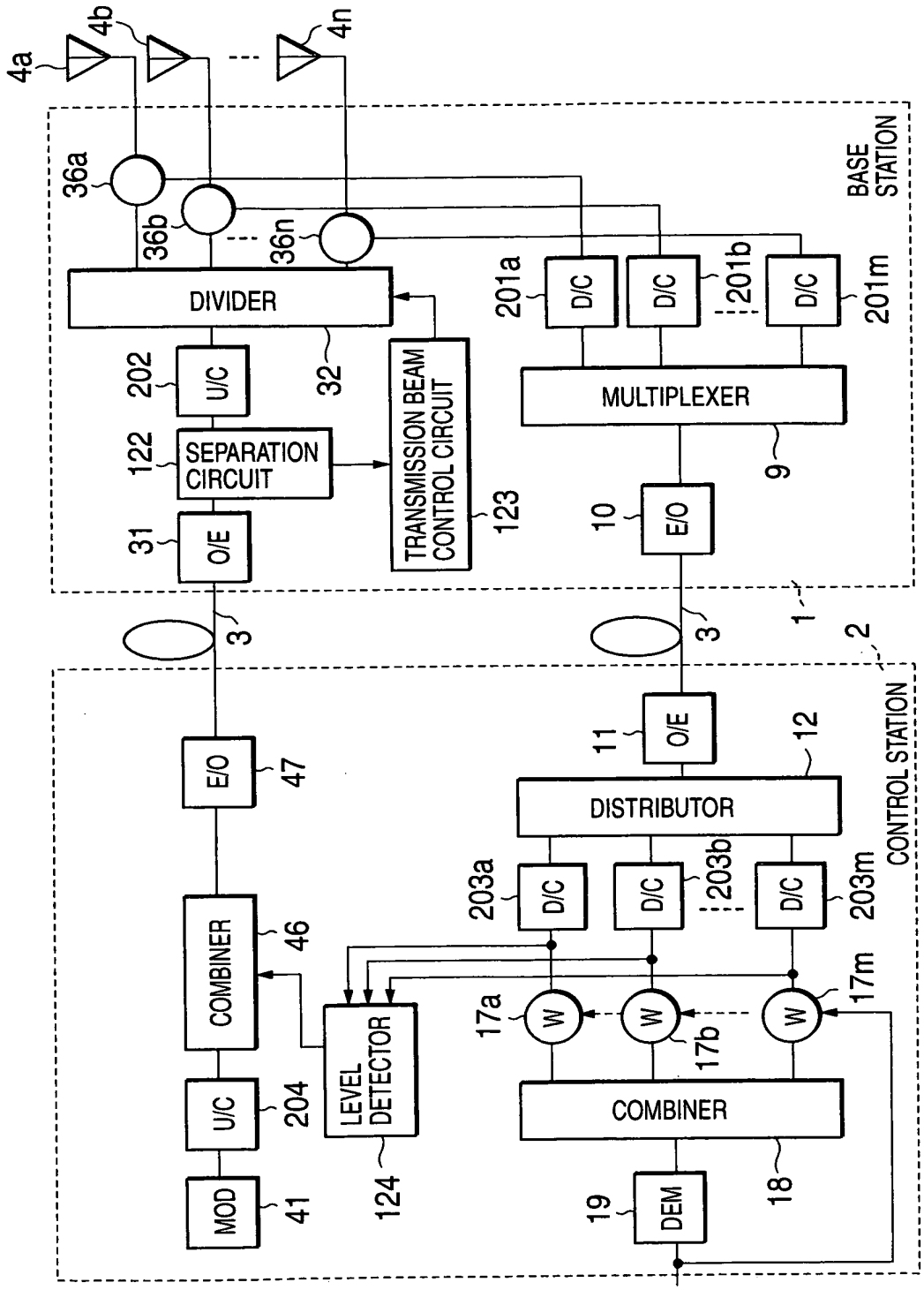
4a
4b
4n
36a
36b
36n
DIVIDER
32
202
U/C
122
SEPARATION CIRCUIT
31
O/E
TRANSMISSION BEAM CONTROL CIRCUIT
123
BASE STATION
201a
D/C
201b
201m
MULTIPLEXER
9
10
E/O
3
1
2
11
O/E
12
DISTRIBUTOR
203a
203b
203m
CONTROL STATION
E/O
47
COMBINER
46
U/C
204
MOD
41
LEVEL DETECTOR
124
17a
17b
17m
W
COMBINER
18
19
DEM

FIG.28

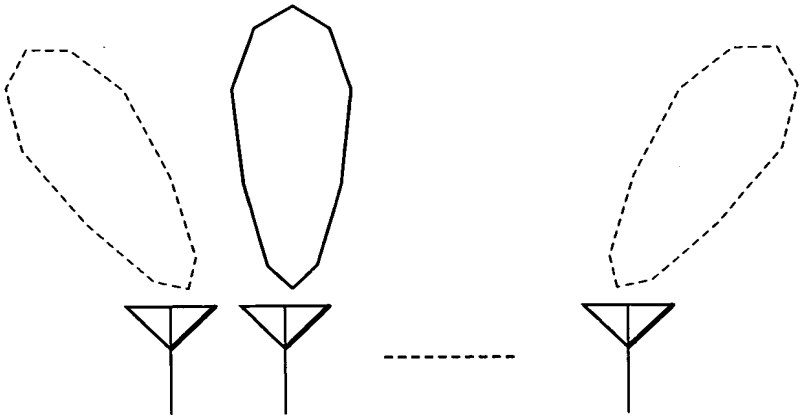

FIG.29A

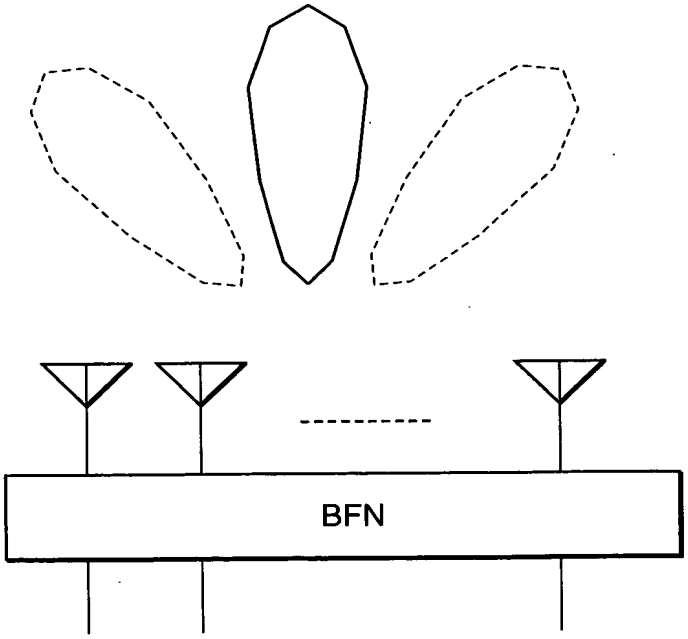

FIG.29B

09560467 .091200

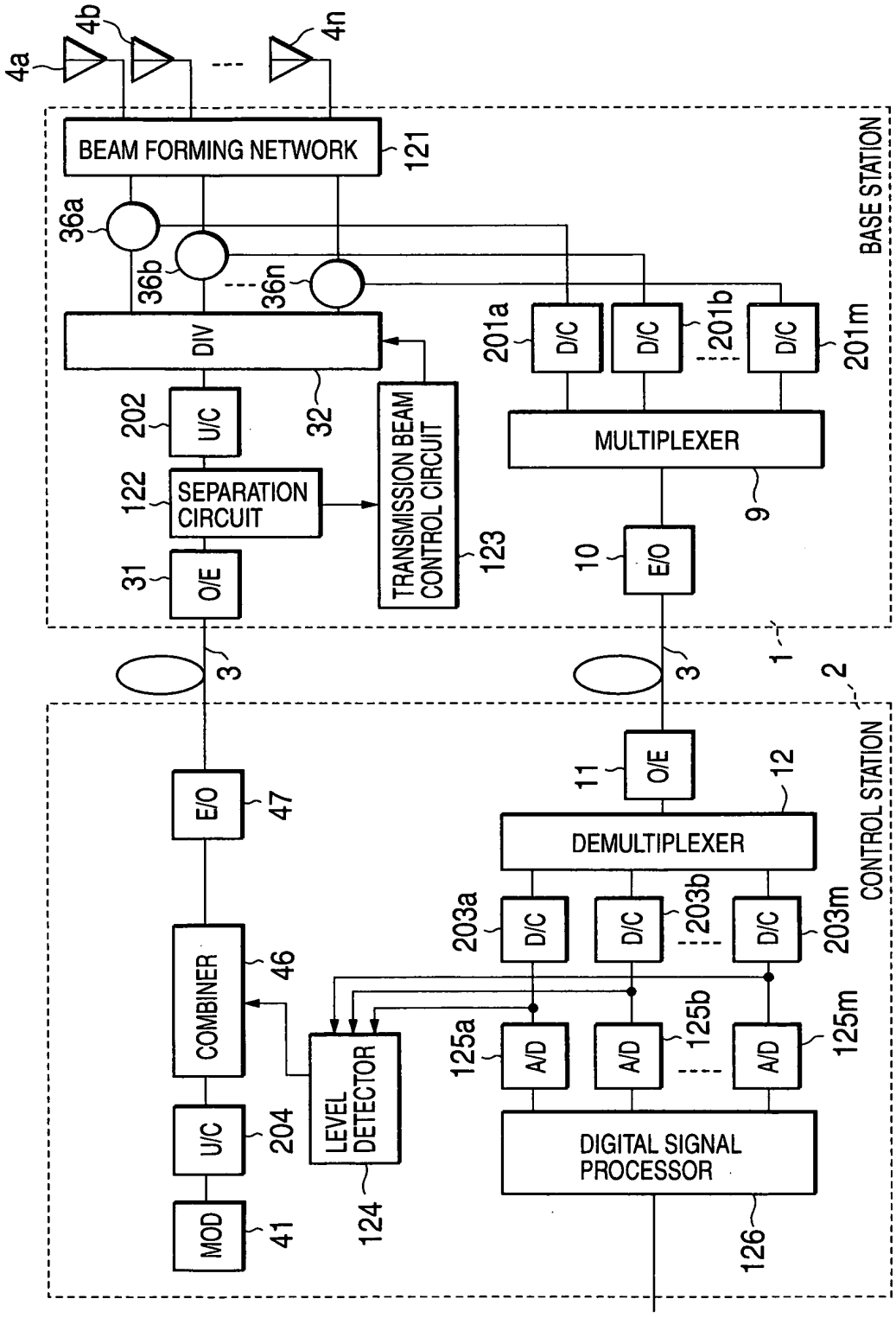
4a
4b
4n
BEAM FORMING NETWORK
121
36a
36b
36n
DIV
32
202
U/C
122
SEPARATION CIRCUIT
31
O/E
TRANSMISSION BEAM CONTROL CIRCUIT
123
201a
D/C
201b
201m
MULTIPLEXER
9
10
E/O
BASE STATION
1
3
3
2
11
O/E
12
DEMULTIPLEXER
203a
203b
203m
CONTROL STATION
E/O
47
COMBINER
46
U/C
204
MOD
41
LEVEL DETECTOR
124
125a
125b
125m
A/D
DIGITAL SIGNAL PROCESSOR
126

FIG.30

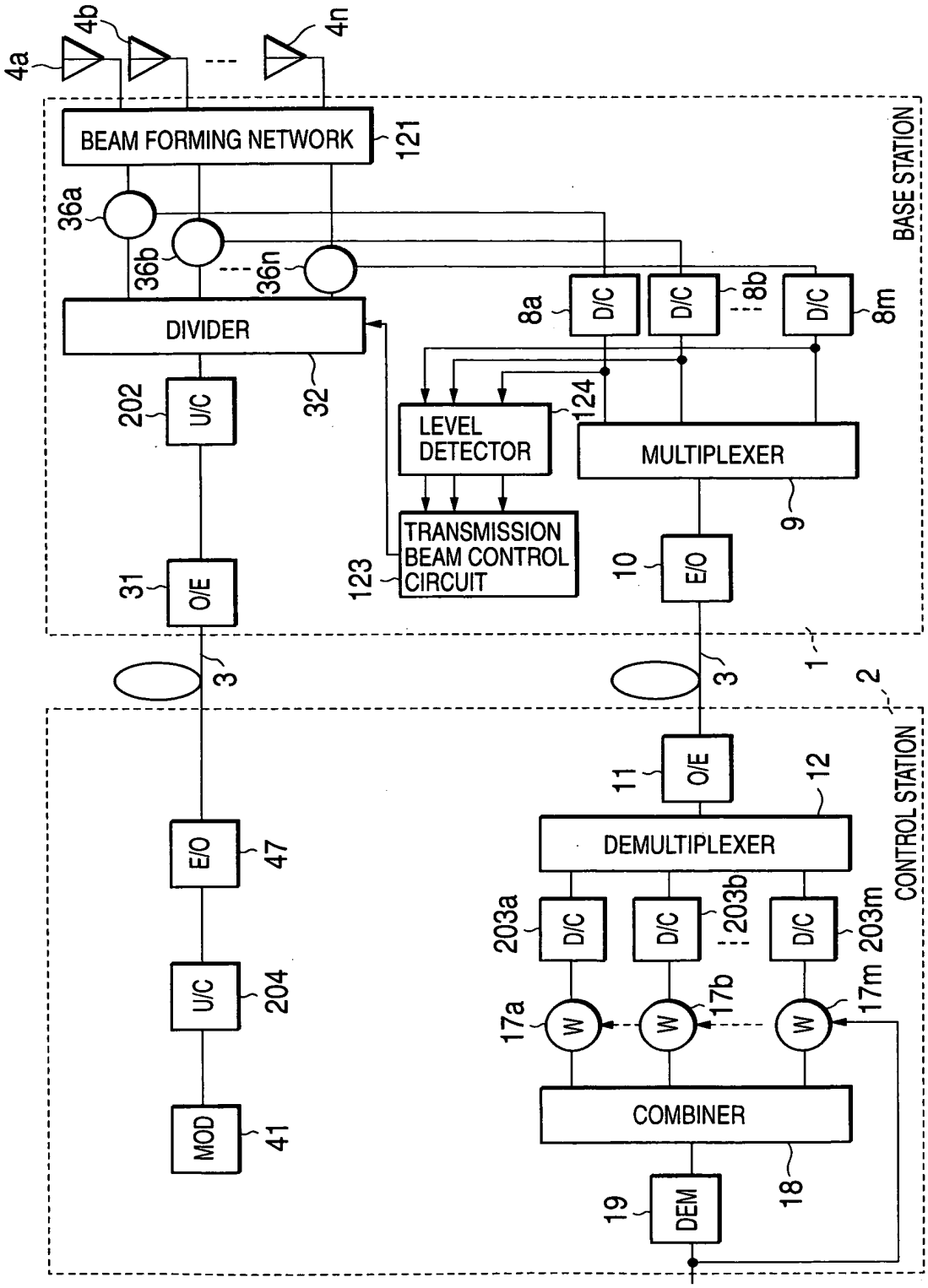
4a
4b
4n
BEAM FORMING NETWORK
121
36a
36b
36n
DIVIDER
32
202
U/C
31
O/E
3
BASE STATION
8a
D/C
8b
8m
LEVEL DETECTOR
124
MULTIPLEXER
9
TRANSMISSION BEAM CONTROL CIRCUIT
123
10
E/O
1
2
3
11
O/E
12
DEMULTIPLEXER
CONTROL STATION
203a
203b
203m
17a
17b
17m
W
COMBINER
18
19
DEM
E/O
47
U/C
204
MOD
41

FIG.31

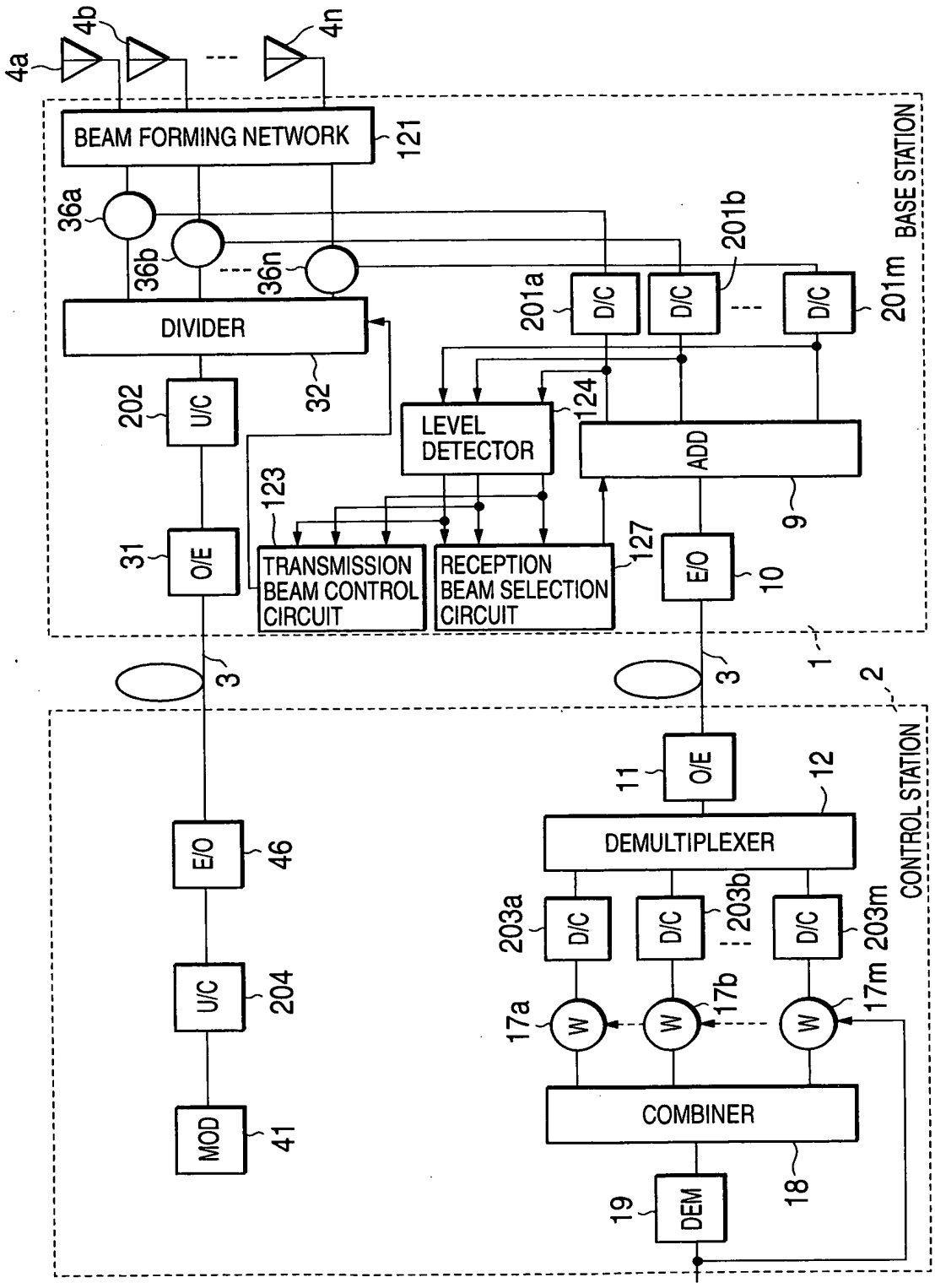

FIG.32

0027609 "2 9 4 0 5 9 6 0

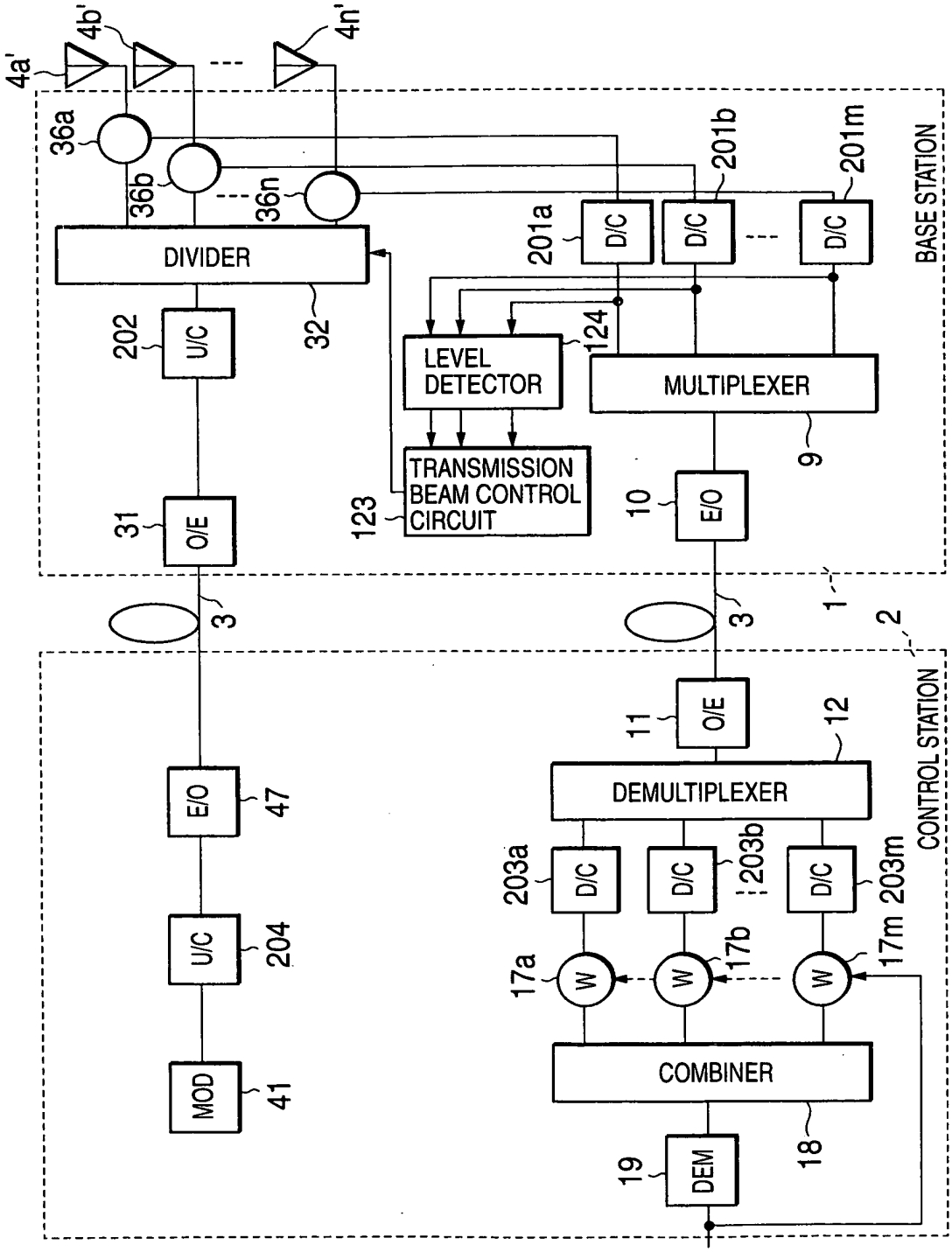
4a'
4b'
4n'
36a
36b
36n
DIVIDER
32
202
U/C
31
O/E
3
E/O
47
U/C
204
MOD
41
BASE STATION
201a
201b
201m
D/C
D/C
D/C
LEVEL DETECTOR
124
MULTIPLEXER
9
TRANSMISSION BEAM CONTROL CIRCUIT
123
10
E/O
3
1
2
CONTROL STATION
11
O/E
12
DEMULTIPLEXER
203a
203b
203m
D/C
D/C
D/C
17a
17b
17m
W
W
W
COMBINER
18
19
DEM

FIG.33

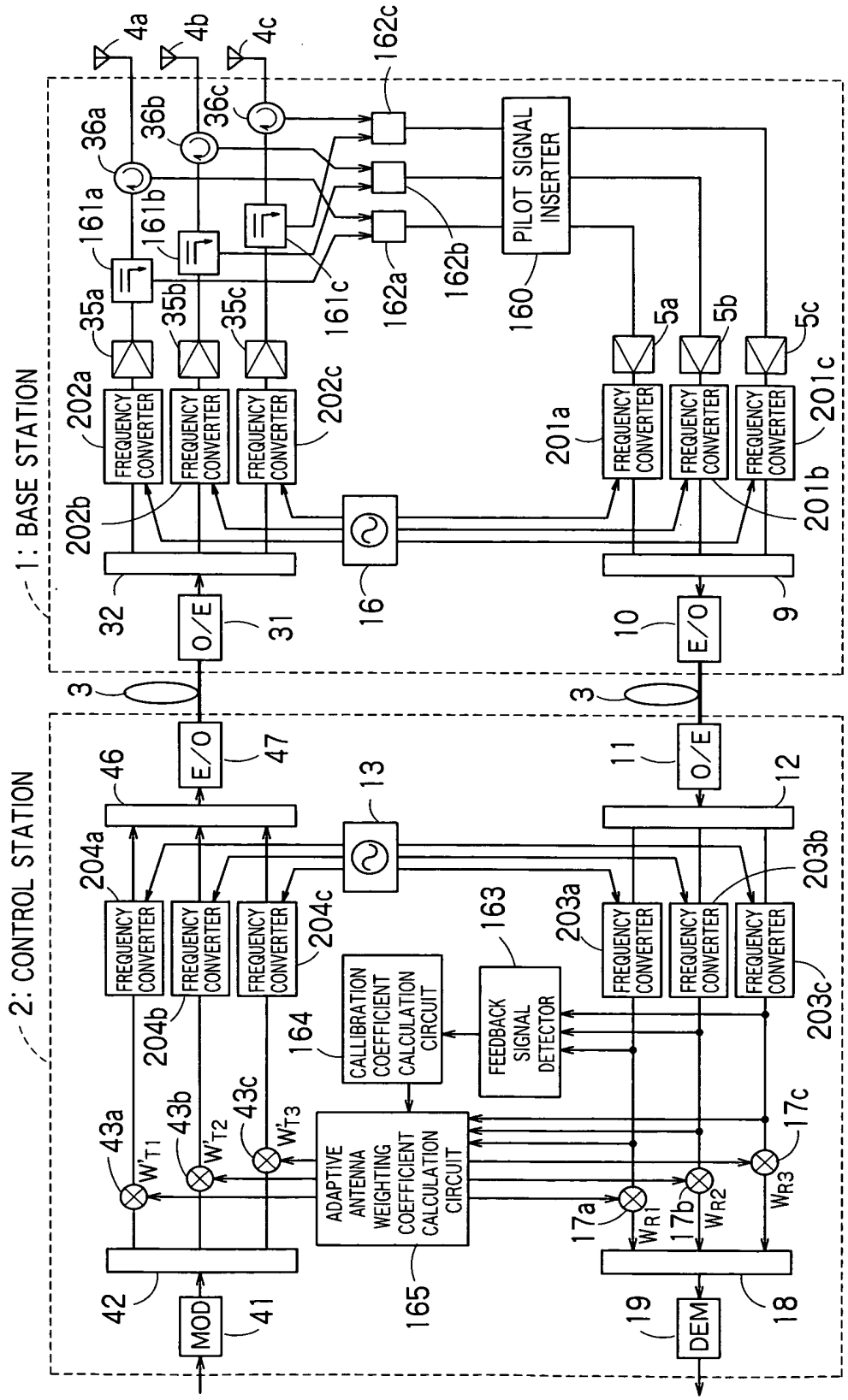
1: BASE STATION
2: CONTROL STATION
PILOT SIGNAL INSERTER
FREQUENCY CONVERTER
O/E
E/O
MOD
DEM
CALLIBRATION COEFFICIENT CALCULATION CIRCUIT
FEEDBACK SIGNAL DETECTOR
ADAPTIVE ANTENNA WEIGHTING COEFFICIENT CALCULATION CIRCUIT
4a
4b
4c
5a
5b
5c
9
10
11
12
13
16
17a
17b
17c
18
19
31
32
35a
35b
35c
36a
36b
36c
41
42
43a
43b
43c
46
47
160
161a
161b
161c
162a
162b
162c
163
164
165
201a
201b
201c
202a
202b
202c
203a
203b
203c
204a
204b
204c

FIG. 34

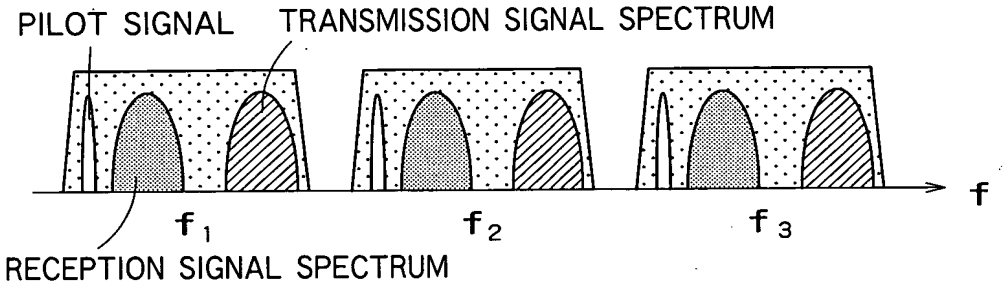
PILOT SIGNAL
TRANSMISSION SIGNAL SPECTRUM
f
f1
f2
f3
RECEPTION SIGNAL SPECTRUM

FIG. 35

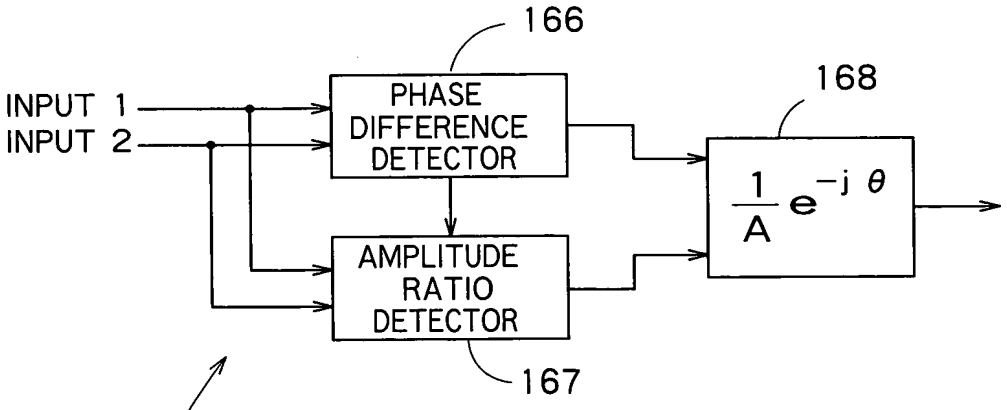
166
168
INPUT 1
INPUT 2
PHASE DIFFERENCE DETECTOR
AMPLITUDE RATIO DETECTOR
1/A e^-jθ
167
164: CALIBRATION COEFFICIENT CALCULATION CIRCUIT

FIG. 36

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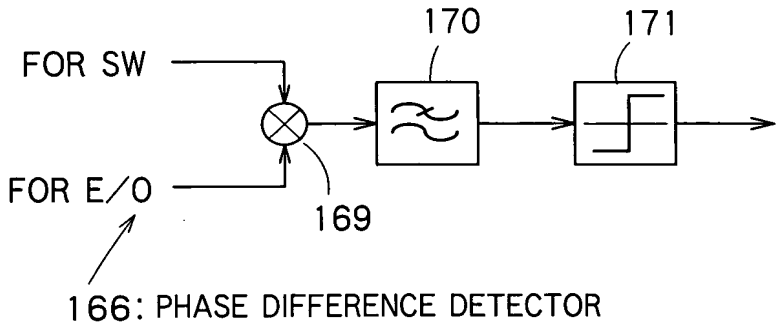

FIG. 37

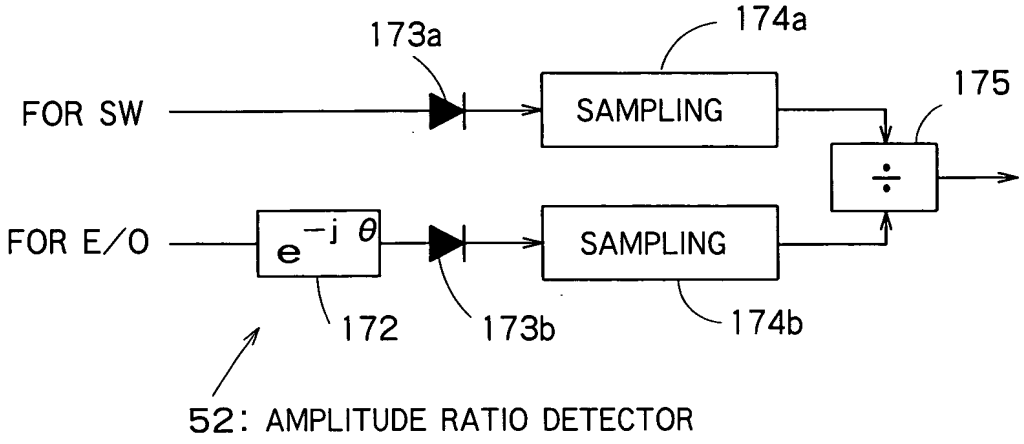

FIG. 38

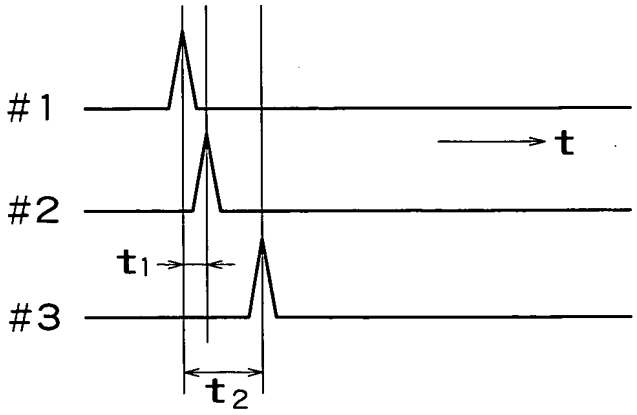

FIG. 39

0956045 - 0951200

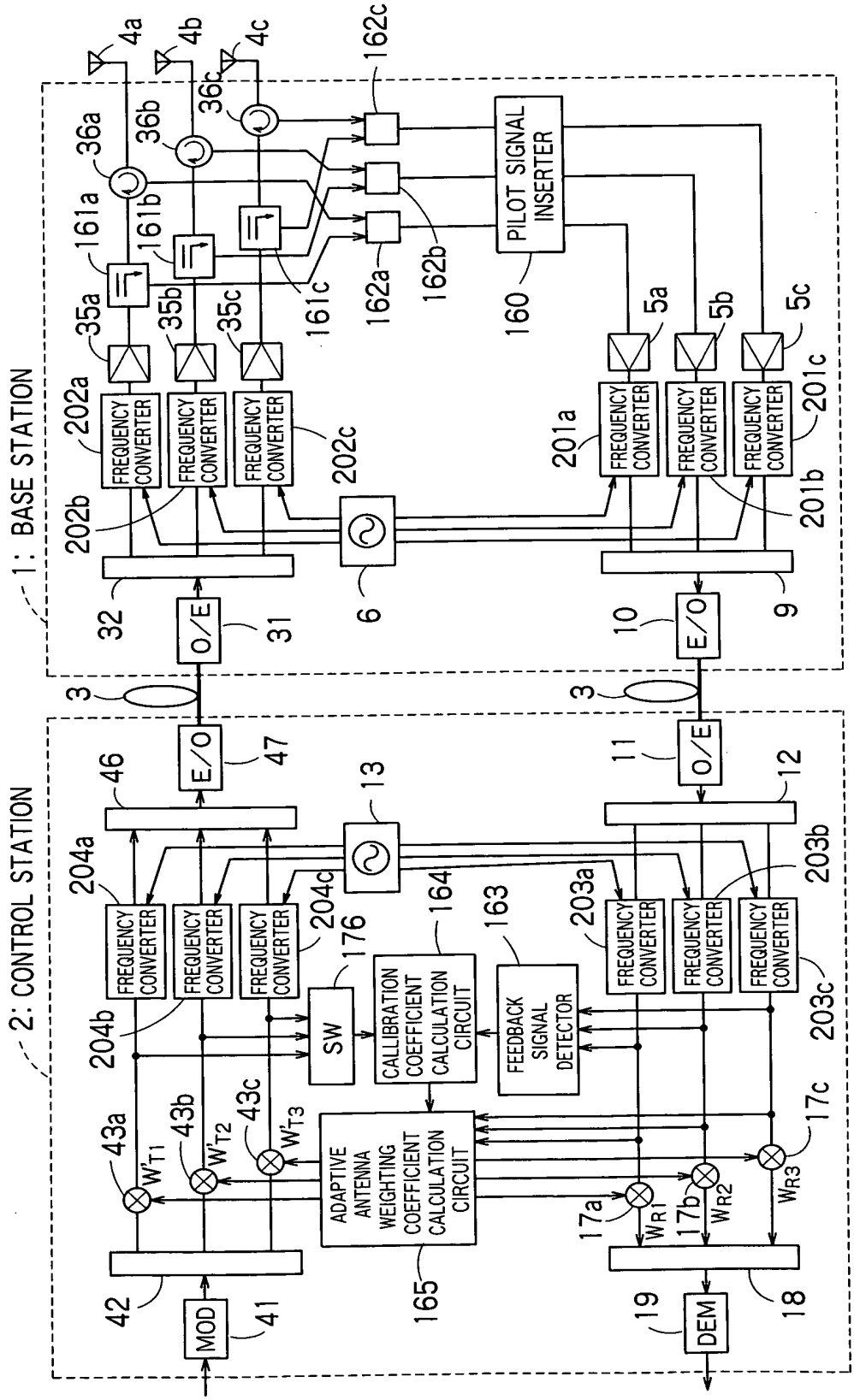
1: BASE STATION
2: CONTROL STATION
FREQUENCY CONVERTER
PILOT SIGNAL INSERTER
O/E
E/O
SW
CALLIBRATION COEFFICIENT CALCULATION CIRCUIT
FEEDBACK SIGNAL DETECTOR
ADAPTIVE ANTENNA WEIGHTING COEFFICIENT CALCULATION CIRCUIT
MOD
DEM

FIG. 40

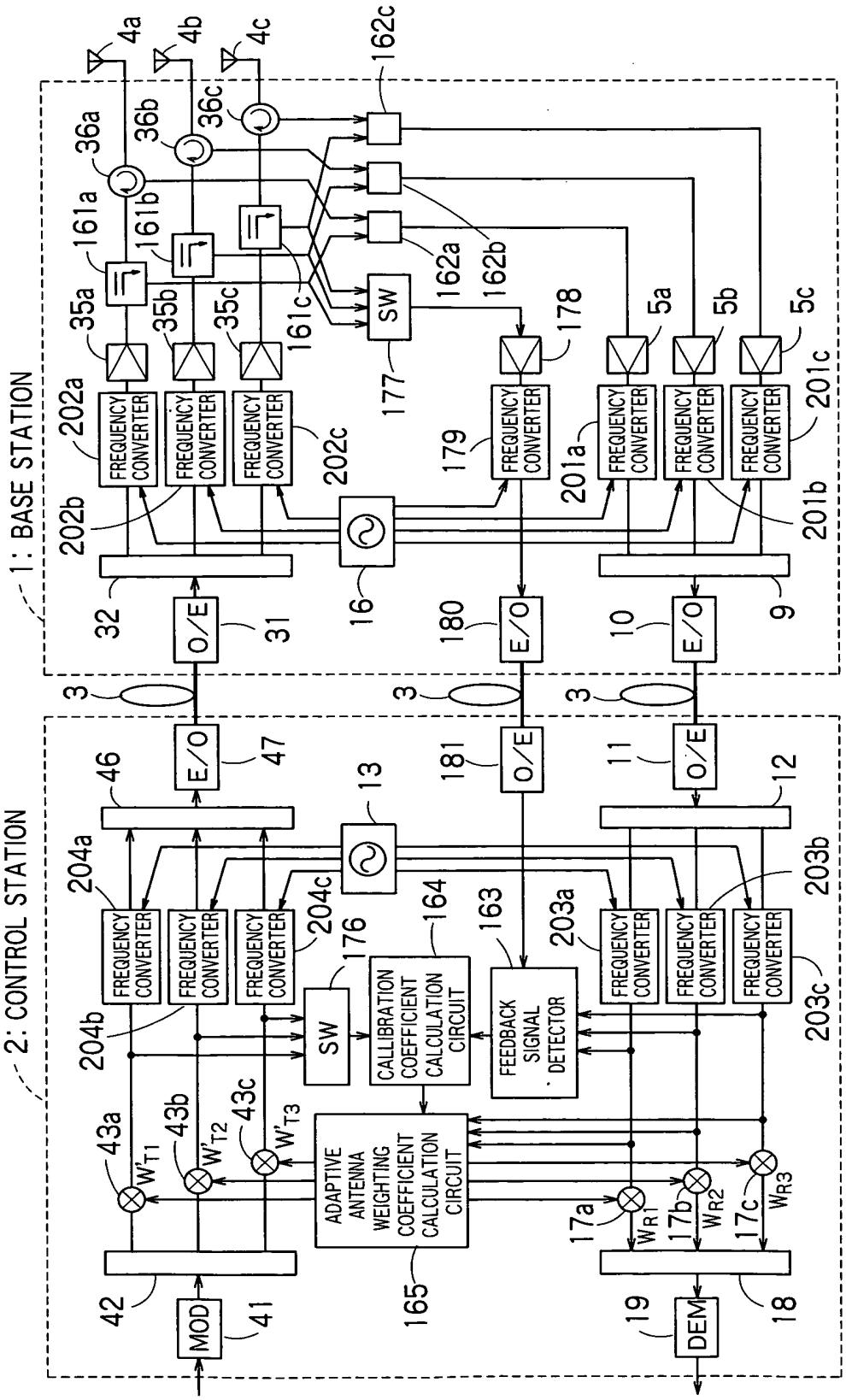
1: BASE STATION
2: CONTROL STATION
FREQUENCY CONVERTER
O/E
E/O
SW
CALLIBRATION COEFFICIENT CALCULATION CIRCUIT
FEEDBACK SIGNAL DETECTOR
ADAPTIVE ANTENNA WEIGHTING COEFFICIENT CALCULATION CIRCUIT
MOD
DEM

FIG. 41

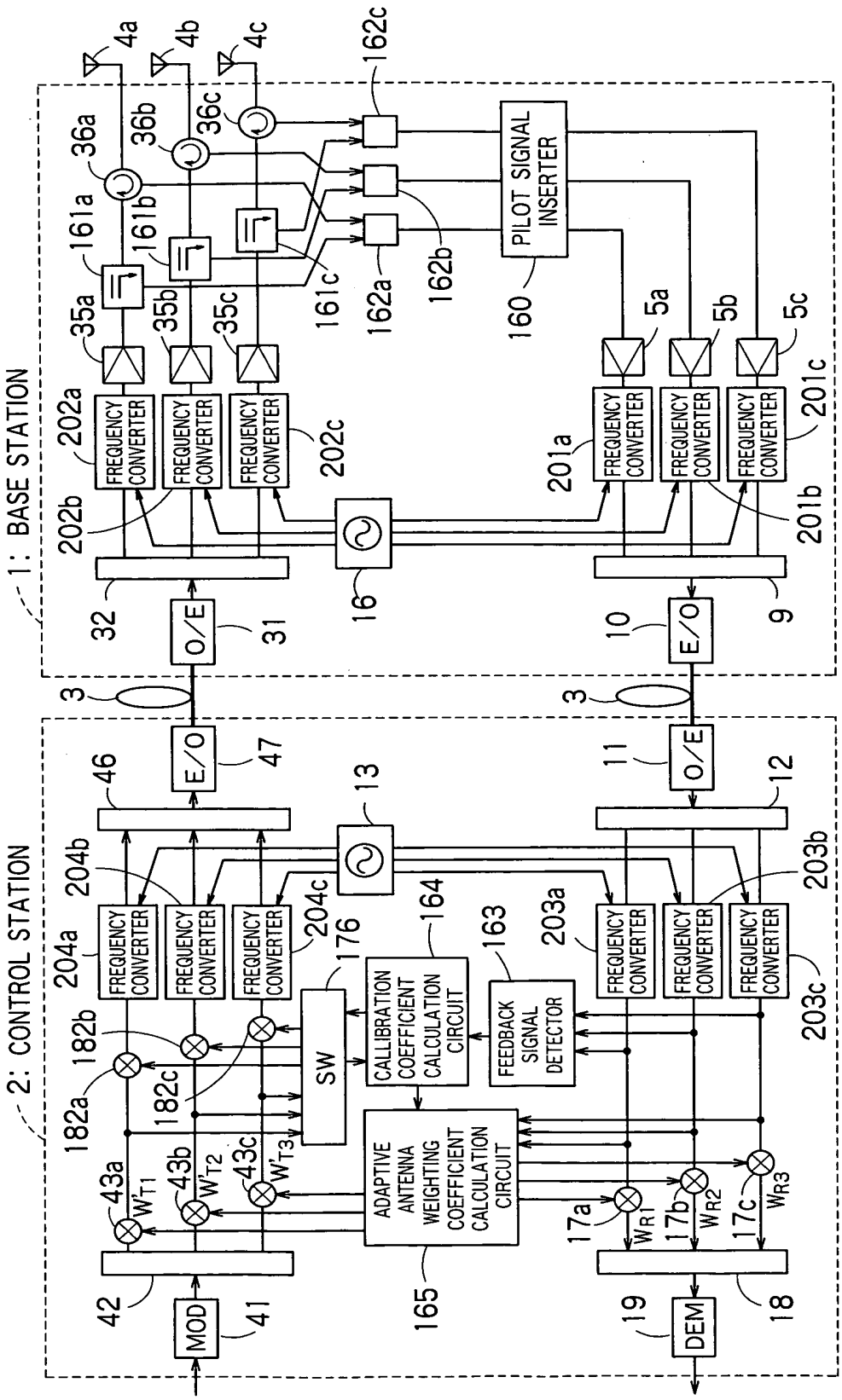
1: BASE STATION
2: CONTROL STATION
4a
4b
4c
36a
36b
36c
161a
161b
161c
162a
162b
162c
35a
35b
35c
PILOT SIGNAL INSERTER
160
5a
5b
5c
FREQUENCY CONVERTER
202a
202b
202c
201a
201b
201c
32
O/E
31
16
10
E/O
9
3
46
E/O
47
13
11
O/E
12
204a
204b
204c
176
164
163
203a
203b
203c
SW
CALLIBRATION COEFFICIENT CALCULATION CIRCUIT
FEEDBACK SIGNAL DETECTOR
182a
182b
182c
43a
43b
43c
W'_{T1}
W'_{T2}
W'_{T3}
ADAPTIVE ANTENNA WEIGHTING COEFFICIENT CALCULATION CIRCUIT
165
17a
17b
17c
W_{R1}
W_{R2}
W_{R3}
42
MOD
41
19
DEM
18

FIG. 42

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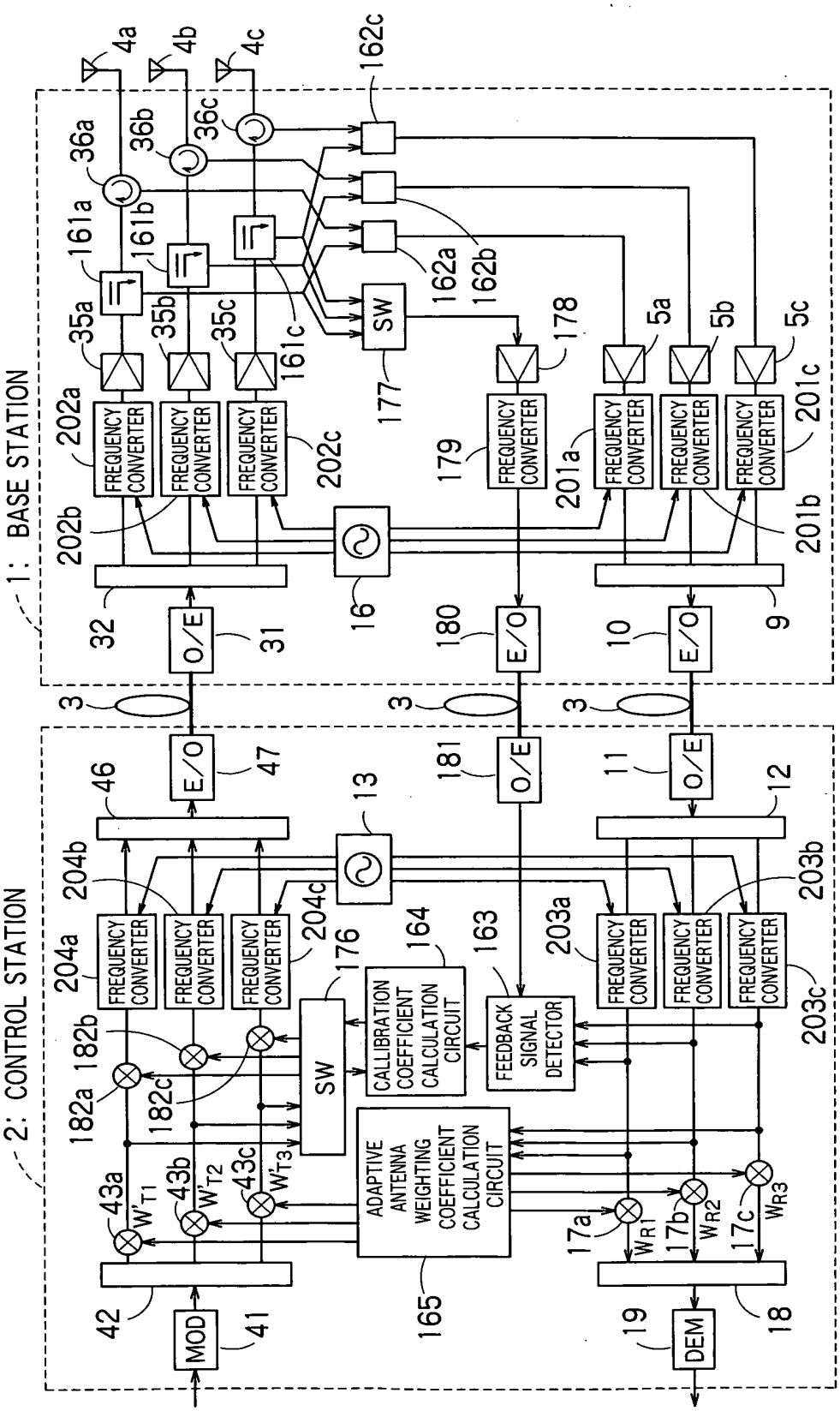

FIG. 43